

SEPTEMBER, 1938.

GENERAL PHYSICS.

ADSORPTION (see Surface Properties).

ATOMIC AND MOLECULAR STRUCTURE.

3432. Passage of Particles through Spherical Potential Barriers.

G. Badarau. *Comptes Rendus*, 207. pp. 39-42, July 4, 1938.—A mathematical treatment, for the case of nuclear charged particles, is developed, based on the Brillouin-Wentzel approximation method, and an expression for the transmission coefficient is deduced. Results are considered in relation to Al. N. M. B.

3433. Constitution of Atomic Nuclei. A. Véronnet. *Comptes*

Rendus, 207. pp. 42-44, July 4, 1938.—A theoretical system is developed by which the constitution of the elements and their isotopes can be successively built up on the basis of the nuclear constitution of H_2^+ and H_3^+ , and a general expression for the constitution is derived. N. M. B.

3434. Structure of Atomic Nuclei. F. J. de Wiśniewski. *Acta*

Physica Polonica, 7. 1. pp. 5-9, 1938. In French.—A theory of γ -radiation without nuclear transformation is developed and applied to ${}^7_3\text{Li}$. Calculated and experimental values are in good agreement. W. R. A.

3435. Interaction Forces in Electrodynamics and in the Field

Theory of Nuclear Forces. E. C. G. Stueckelberg. *Helv. Phys. Acta*, 11. 4. pp. 299-328, 1938. In German.—The mathematical properties of interactions transmitted by intermediate particles (such as photons, heavy electrons, etc.) are investigated by the method of many times. R. P.

3436. Charge-Dependence of Nuclear Forces. N. Kemmer.

Cambridge Phil. Soc., Proc. 34. pp. 354-364, July, 1938.—In this mathematical paper the author deduces by specialisation a satisfactory theory of heavy quanta, charged and uncharged, collects the essential equations in a practical form, and then discusses in detail the most important application, viz., the resulting nuclear potential. H. H. Ho.

3437. Binding Energies of Hydrogen Isotopes. A. H. Wilson.

Cambridge Phil. Soc., Proc. 34. pp. 365-374, July, 1938.—The wave equation for the deuteron in its ground state is solved on the assumption that the mutual potential energy of a neutron and a proton is of the form $r^{-1}e^{-\lambda r}$. The binding energy of H^3 is calculated approximately by the variation method. AUTHOR.

3438. Isotope Abundance of Common Lead. A. O. Nier.

Am. Chem. Soc., J. 60. pp. 1571-1576, July, 1938.—A mass spectrographic study of the isotopes of 12 samples of common lead shows that the relative abundances vary considerably in spite of a nearly constant atomic weight. A tentative explanation for the variations is found if one arbitrarily considers some of the samples to be "uncontaminated" lead and the others "uncontaminated" lead to which has been added approximately equal quantities of uranium and thorium leads. As the minerals from which the lead was obtained are essentially free of Th and U, such contamination

probably took place before the mineral was formed. A search for the isotopes Pb^{210} , Pb^{209} , Pb^{205} , and Pb^{203} indicated that if such isotopes exist at all they must exist with much lower abundances than was at one time supposed. AUTHOR.

3439. Fractionation of Li and K Isotopes by Chemical Exchange with Zeolites. T. I. Taylor and H. C. Urey. *J. Chem. Phys.* 6. pp. 429-438, Aug., 1938.—A study has been made of the fractionation of Li isotopes by electrolysis and of the Li, K and N isotopes by chemical exchange with zeolites. The fractionation factor obtained by a "batch" electrolysis of LiCl solution was 1.039. The normal abundance ratio of the Li and K isotopes was determined and found to be 11.71 ± 0.14 for $\text{Li}^7 : \text{Li}^6$ and 14.10 ± 0.09 for $\text{K}^{39} : \text{K}^{41}$. The fractionation factor for the Li isotopes in exchange with sodium zeolite was found to be 1.022. A partial separation of the Li, K and N isotopes has been effected using long columns filled with zeolites. Both an increase and a decrease of about 25% from the normal abundance ratio has been obtained for the Li isotopes and a change of about 10% for the K and N isotopes. Some of the factors involved in the mechanism of the process are discussed. AUTHORS.

3440. Isotopic Constitution of Sr, Ba, Bi, Tl and Hg. A. O. Nier. *Phys. Rev.* 54. pp. 275-278, Aug. 15, 1938.—A mass-spectrographic study of the isotopic constitution of Sr, Ba, Bi and Tl has been made. Although the sensitivity and resolving power of the apparatus were sufficient to detect extremely rare isotopes, no new ones were found. Relative abundances of the isotopes of Sr, Ba and Tl were determined. It was possible to show that if Hg^{203} exists it must be with an abundance less than one-tenth of that at one time assigned to it by Aston. AUTHOR.

3441. Electron Diffraction Study of Di- and Tri-Germane. L. Pauling, A. W. Laubengayer and J. L. Hoard. *Am. Chem. Soc., J.* 60. pp. 1605-1607, July, 1938.—The Ge-Ge bond distance in both digermane and trigermane is found by the electron diffraction method to be about 2.41 ± 0.02 Å. AUTHORS.

3442. Atomic and Ionic Radii. Parts I and II. W. Hume-Rothery and G. V. Raynor. Part III. G. V. Raynor. *Phil. Mag.* 26. pp. 129-165, July, 1938.—Part I discusses what constitutes the size of an atom in a metallic structure. There are two general types of structure, i.e., the "open" type in which the ionic radius is small compared with the interatomic distance, while in a lattice of the "full" type the ionic radii are nearly equal to the interatomic distances. Consequently their properties differ considerably. There should be a difference in the compressibilities of metals of the two types, and this is substantially borne out by experiment. In an open type of lattice the valency electrons control the properties, and to a first approximation they may be treated as an electron gas. It can be shown that the compressibility is proportional to $(V/N)^{5/3}$ where N is the number of electrons in volume V, and V is the extra-ionic volume in the unit cell. The experimental data of Bridgman for the alkali metals are in agreement with this theory. The departures of other metal lattices are considered and it may be claimed that the compressibilities agree with the picture of metals given by considering atomic radii and extra-ionic volumes. In Part II the theory is applied to the problem of alloys. Examples are discussed illustrating general principles or systems which have hitherto proved difficult to understand. Although in many cases simple considerations of ionic size give an adequate

explanation of solubility effects, there are complicating factors, one of the most important being mutual deformation of the ions of the constituent metals. This effect is dealt with in detail in Part III. Present knowledge of the polarisation of ions does not, however, permit the considerations of the deformabilities of ions being expanded into a general law for metal systems.

C. J. B. C.

3443. Intermolecular Forces. J. N. Friend. *Faraday Soc., Trans.* 34. pp. 813-816, July, 1938.—Viscosity and density data relating to many organic liquids support the view that the attractive forces between the molecules vary inversely as the eighth power of the distance between them.

P. H. B.

See also Abstracts 3486, 3489, 3490, 3491, 3774, 3816, 3834.

COLLOIDS.

3444. Dispersion of Depolarisation of Light-Scattering in Colloids. R. S. Krishnan. *Kolloid Zeits.* 84. pp. 2-8, July, 1938.—The imperfection of the polarisation ("depolarisation") of the Tyndall scattering, in colloids can be expressed in terms of the quantities ρ_u , ρ_v , and ρ_h . Here ρ is the ratio of the intensity of the weaker component to the stronger, when the scattering is through 90° . u , v and h are applied to the three cases of the incident light being unpolarised, or vertically or horizontally polarised, respectively. To draw conclusions as to the magnitude, nature and structure of the colloid particles, a determination of each of these three quantities is necessary. ρ_v gives information about the nature or structure of the particles, ρ_h about their size. They are related with ρ_u by $\rho_u = \left(1 + \frac{1}{\rho_h}\right) / \left(1 + \frac{1}{\rho_v}\right)$. This holds for all wave-lengths and particles, provided the latter are randomly distributed. When the particles are large and aspherical, the depolarisations show a great dependence on the wave-length of the incident beam. An experimental method is described for measuring this dispersion of the depolarisation. Conditions for this dispersion to occur with any colloid solution, are discussed. [See following Abstract.]

A. C. M.

3445. Molecular Aggregation and Light Scattering. R. S. Krishnan. *Kolloid Zeits.* 84. pp. 8-15, July, 1938.—The phenomenon of opalescence, which is exhibited by liquid mixtures near the critical solution temperature, is described, and some consequences of opalescence are explained. The colloidal nature of such liquid mixtures, neglected by others, is discussed with reference to the colour of the opalescence, and to the anomalies in the viscosity and in the electrical, magnetic and mechanical double refraction. The optical methods, which measure ρ_h [see preceding Abstract] are apt for finding molecular aggregation, and so for demonstrating the similarity of critical liquid mixtures, and colloidal emulsions. The results are described in this paper. The method is sensitive, and shows such an aggregation to be already occurring in liquid mixtures already well below the opalescence temperature.

A. C. M.

3446. Effect of Electrolytes on the Viscosity of $\text{Fe}(\text{OH})_3$ Sol. S. Thévenet. *Comptes Rendus*, 207. pp. 68-71, July 4, 1938.—The effect of KCl, NaCl, NH_4Cl , BaCl_2 , AlCl_3 and ThCl_4 on the viscosity of a $\text{Fe}(\text{OH})_3$ sol was first investigated. Being a positively charged sol it would be expected that the kation of the added electrolyte would be

ineffective and this was verified. When the effect of KCl , K_2SO_4 , K_3PO_4 , and $\text{K}_4\text{Fe}(\text{CN})_6$ was investigated it was found that the concentration of the added electrolyte for which the viscosity of the sol was a minimum depended chiefly on the valency of the anion. In the case of salts with polyvalent anions, e.g., K_3PO_4 , $\text{K}_4\text{Fe}(\text{CN})_6$, and sodium citrate, for which there are two zones of coagulation, the effect on the viscosity was determined for both zones. A. J. M.

3447. Optical Study of Isothermal and Non-Isothermal Sol $\rightarrow$ Gel Transformations. W. Heller and E. Vassy. *Comptes Rendus*, 207. pp. 157-159, July 11, 1938.—The authors submit an experimental proof, based on the behaviour of an aqueous alcoholic thixotropic solution of a dehydrated gelatin, that there is only one method of gel formation, and that different cases such as were distinguished by Heymann [see Abstract 1411 (1936)] only differ in the speeds with which they are produced. H. H. Ho.

3448. Sedimentation Volume and Thixotropy. H. Akamatu. *Chem. Soc. Japan, Bull.* 13. pp. 456-462, June, 1938.—Measurements were carried out on the sedimentation volume when a powder settled in an organic liquid or solution. A parallelism was found between the large sedimentation volume of the powder and the thixotropic nature of the system. AUTHOR.

3449. Lyophilic Properties of Cellulose Derivatives. K. Kanaamaru, T. Takada and K. Maeda. *Kolloid Zeits.* 84. pp. 42-50, July, 1938.—The ζ -potential and its temporary alteration due to immersion of nitrocellulose of different N content in water, methyl and ethyl alcohol, and the relationship thereto of swelling ability is investigated. The results are again in accordance with the previous formula, etc., of Kanaamaru. It is also established that the ζ -potential of nitrocellulose is higher according as the swelling ability of the nitrocellulose is higher for the liquid used for immersion. ζ_∞ , i.e., the limiting value of the potential, is lower in value according as the value $\zeta_0 - \zeta_\infty$ is greater, or less, i.e., according to the degree of turgescence of the nitrocellulose. The zero point is reached when the nitrocellulose is approximately dissolved. [See Abstracts 2331 and 3334 (1937).] S. G. B.

3450. Hydrophilic Properties of Cellulose. Part VI. K. Kanaamaru, A. Shiratori and T. Nakamura. *Kolloid Zeits.* 84. pp. 50-62, July, 1938.—In order to render the cellulose foil waterproof without damaging its other properties, it is pretreated with a solution of Al salts of high organic acids. Thus the penetration of the hydrophobic softening material is effected into the inner structure of the foil where by means of the hydrophobic carbohydrate linkage the fixation of the soap molecule is effected. The influence of the adsorption of the Al soap on the characteristics of the foil, particularly in regard to water vapour penetration and hygroscopic nature, has been investigated. [For Part V see Abstract 1438 (1937).] S. G. B.

3451. Test of Alternative Structures Proposed for Cellulose. S. T. Gross and G. L. Clark. *Zeits. f. Krist.* 99. 5. pp. 357-366, 1938.—A number of oriented cellulose materials have been investigated in an effort to determine whether the unit cell for cellulose proposed by Sauter [see Abstract 4791 (1937)] is more consistent with the X-ray evidence than that originally postulated by Meyer and Mark. A number of patterns have been made of tunicin, bacterial cellulose and *valonia ventricosa*. All patterns were consistent with the Meyer-Mark unit cell. AUTHORS.

3452. Electrokinetic Properties of Activated Charcoal. H. L. Bennister and A. King. *Chem. Soc., J.* pp. 991-997, July, 1938.—Although much work has been published on adsorption by charcoal, little information is available as to the fundamental changes in the electrical condition of the surface, which take place on activation under various conditions. As a result of extensive preliminary work, a standard technique has been developed for obtaining reproducible measurements of the kataphoretic migration velocity of charcoal suspensions by a method using the principle of the ultramicroscope. It is found that equilibrium conditions are set up after 4-5 hours' activation at a given temperature, and that the kataphoretic velocity varies in the same way as adsorptive capacity. Oxygen-activated charcoal is always negatively charged in pure water, there being a pronounced maximum with samples activated at *ca.* 850°. The effect of the concentration of the charcoal suspension on kataphoretic velocity is also studied. AUTHORS.

3453. Electrophoretic Mobility of Tristearin in Presence of Chlorides. D. I. Breese and W. C. M. Lewis. *Faraday Soc., Trans.* 34. pp. 787-793, July, 1938.—Results are reported for dispersed purified tristearin in solutions of chlorides of Na, Ba, La, Al, and Th at 25° C. and pH=4. For Na, Ba, La, limiting mobilities without reversal of direction are obtained, for Al a zero value at 1.4×10^{-3} mole/litre. The difference between LaCl_3 and AlCl_3 is attributed to hydrolysis in the latter case, even at constant pH. When the pH alters (as a result of hydrolysis of AlCl_3) the electrophoretic behaviour is markedly different. With ThCl_4 the mobility falls to zero at 2.2×10^{-6} mole/litre, even when pH is maintained at 4 in order to repress hydrolysis. The relative discharging effect of Na^+ , Ba^{++} and La^{+++} kations is in good agreement with the Gouy theory, but not that of Al- and Th-; in the case of these two, colloidal hydrolytic products probably interfere. Attention is drawn to the increase in electro-kinetic charge density (calculated by Gouy's relation) with increasing electrolyte concentration, this cannot be explained by capillary data, which are necessarily obtained at a liquid-liquid interface.

D. R. H.

3454. Crystallisation of Rubber through Pressure. P. A. Thiessen and W. Kirsch. *Naturwiss.* 26. pp. 387-390, June 17, 1938.—Previous investigation had shown rubber to be a solid-liquid system in which equilibrium was dependent not only on temperature but also markedly on pressure. 1 mm. bands 10 mm. in dia. are prepared by pouring latex over glass plates, and tested in a flexible vacuum-tight metallic tube enclosed axially in a similar wider tube. On evacuation of the annulus a pressure up to 100 atm. can be generated in the inner, and temperature can be held remarkably constant for months on end if proper precautions are taken. X-Ray exposures are taken through a 0.6 mm. stop for 5-20 min., the progress of freezing being shown by increasing definition of the rings. At 4-6° C. all specimens, whether pressed or not, showed rings; at 8° the rings were still weak after 71 days and slowly improved; above 8° the halo persisted for as long as 141 days, whether pressure was applied or not. Structures after 50, 80, 127 days are tabulated, for 7° C. at zero and 10 atm. pressure, for 8° C. at zero and 15 atm. pressure, for 9° C. at zero and 20 atm., and for 10° C. at zero and 25 atm. It is clear that uniform pressure influences the crystallisation, and increases surfusion. The favourable influence of pressure may be due either to enhanced velocity

of crystallisation or to promotion of nuclei formation. It is qualitatively established that velocity of crystallisation diminishes with falling temperature. At normal pressure a m.pt. of 20–23° C. for rubber is deduced. D. R. H.

***3455. Ultrasonic Centrifuge.** P. Girard and N. Marinesco. *Comptes Rendus*, 206. pp. 2000–2002, June 27, 1938.—An apparatus is described in which material to be centrifuged is also submitted to the action of ultrasonic waves, the object being to extract ferments, viruses, and hormones without alteration in composition from cells and tissues at low temperatures. A. J. M.

***3456. Vacuum Type Air-Driven Centrifuge for Biophysical Research.** J. W. Beams, F. W. Linke and P. Sommer. *Rev. Sci. Instruments*, 9 pp. 248–252, Aug., 1938.—An improved vacuum type self-balancing centrifuge which is driven by air is described. It is especially suited for spinning rotors larger than 2 inches in diameter at very constant temperatures. Either the "quantity" or "analytical" type of rotor may be used with the same driving mechanism. AUTHORS.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

3457. Twinning and Coalescence in Lattices of Close Packed Spheres. G. Menzer. *Zeits. f. Krist.* 99. 5. pp. 378–409, 1938.—The paper is divided into three parts and deals with various lattices built of close packed spheres. In Part I equations are derived for the transformation of the lattice coordinates of the one member of a cubic twin to those of the other member. A quasi-cubic super-lattice appears which is common to both members of the twinned cubes. The ratio of the parameter of this quasi-cubic lattice to that of the individual cube is equal to the order number q of a cubic twin. The equations are applied to all three cubic translation lattices. Part II deals with an extension of these transformation equations to the twinning on the (111) face of cubic lattices and to the coalescence of cubic with hexagonal lattices of close packed spheres. In Part III the author discusses certain defects which appear in the region of contact of two twinned lattices. J. I.

3458. Simplified Derivation of the Laue Particle Size Equation. B. E. Warren. *Zeits. f. Krist.* 99. 5. pp. 448–452, 1938.—A simple derivation of the Laue particle size equation is given. The result is compared with the equations of Scherrer and Bragg. AUTHOR.

3459. Diffraction of X-Rays by a Crystal. J. Laval. *Comptes Rendus*, 207. pp. 169–170, July 11, 1938.—The general problem of the diffracting power of amorphous bodies for X-rays is discussed and some results are given of the measurement of the diffracting power in the particular case of sylvine and MoK α radiation. J. I.

3460. Direct Determination of Crystal Structure from X-Ray Data. M. Avrami. *Phys. Rev.* 54. pp. 300–303, Aug. 15, 1938.—The empirical similarity in the behaviour of scattering-factor curves for different atoms is used to replace the structure-factor formulæ by an approximating system. This system is shown to lead to m 'th degree algebraic equations, designated fundamental equations, whose coefficients are calculable in terms of crystal structure and atomic scattering factors. The roots of these equations give the coordinates of the unknown atomic positions. Thus if the values of a sufficient number ($2m$ in general; VOL. XLI.—A.—1938.

$m+1$ where there is a centre of symmetry) of sequential structure-factors are known, the problem of direct structure determination is solved. If only the absolute magnitudes are known, one may derive reciprocal equations of the $m(m-1)$ th degree whose coefficients are calculable in terms of the squared moduli of the structure factors. We can then write fundamental equations of degree $m(m-1)/2$ whose roots give the coordinates of the interatomic distances from which the unknown parameters themselves may readily be determined. If the number of unknown parameters in any projection is m , the minimum number of structure factor moduli required in this case is $m(m-1)+1$. The method developed in the paper is applied to the KH_2PO_4 crystal, and the results are found to compare very well with the values found by West on the basis of a trial-error and Fourier synthesis investigation.

AUTHOR.

3461. Energies of Disorder in Ionic Crystals. W. Jost. *Faraday Soc., Trans.* 34. pp. 860-867, Aug., 1938.—The significance and computation of the energies of disorder are discussed. The energies for different types of disorder are compared. The computation of the height of the energy barrier is considered, together with the dependence of the different energies on temperature. [See Abstract 3825 (1938).] F. J. B.

3462. X-Ray Spectrum and Structure of Cu and Ni in Cu-Ni Alloys. J. Farineau and M. Morand. *Comptes Rendus*, 206. pp. 1895-1896, June 20, 1938.—Examination of intensity-voltage curves for La of Cu in Cu-Ni alloys containing 40 (constantan) and 25% Ni shows that this line for Cu is not appreciably different from that given by the pure metal, but that the same line for Ni is much narrower. A similar effect to that shown by Ni in this alloy is shown by La of Cu when some atoms of Cu are replaced by Zn without change in the crystal lattice, e.g., in α -brass. C. A. S.

3463. X-Ray Study of System Ni-P. H. Nowotny and E. Henglein. *Zeits. f. phys. Chem.* 40. Abt.B. 4. pp. 281-284, 1938.—By means of Debye-Scherrer photographs the authors investigate the structure of Ni-rich alloys in the range 0-35 atom.% P. In addition to phases Ni_3P and Ni_2P , which are isomorphous with the corresponding phases in the Fe-P and Mn-P systems, there are two other phases Ni_5P_2 and Ni_7P_3 . Ni_7P_3 probably has a cubic lattice. In the case of Ni_2P good agreement is obtained between the estimated intensities and those calculated on the assumption that the parameters found for Fe and P atoms in Fe_2P also hold for the Ni and P atoms in Ni_2P . J. I.

3464. X-Ray Investigations in the Systems Mn-Bi, Co-Sb, Ni-Sb. U. Fürst and F. Halla. *Zeits. f. phys. Chem.* 40. Abt.B. 4. pp. 285-307, 1938.—The application of a previously proposed stability criterion for X-ray control of the constitution diagram, is further investigated. (1) In the Mn-Bi system the phase X is found to have a rhombic unit cell with $a = 4.30_8$, $b = 5.24_5$, $c = 6.30_8 \text{ \AA}$, probably Mn_2Bi . The tetragonal cell of γ with $a = 5.83_3$, $c = 5.35_0$ may be MnBi_2 . (2) In the system Co-Sb the phase CoSb is found to have the NiAs lattice with $a = 3.866 \text{ \AA}$, $c = 5.183$; CoSb_2 has the marcasite lattice with $a = 3.20_8$, $b = 5.78_0$, $c = 6.41_5 \text{ \AA}$. (3) In the Ni-Sb system the γ phase has NiAs structure; β has a tetragonal unit cell with $a = b = 5.78_5 \text{ \AA}$, $c = 6.00$, further work is in progress to establish whether this is really Ni_2Sb or Ni_5Sb_2 . The cubic δ is an interstitial solid solution of Ni in Ni_3Sb of composition $\text{Ni}_{13}\text{Sb}_4$. ϵ with rhombic unit cell with $a = 3.20_8 \text{ \AA}$, $b = 5.63_4$, $c = 6.22_8$ shows a marcasite structure. The atomic radii of the

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elements in question are discussed, with special reference to their dependence on structure. D. R. H.

3465. Submicroscopic Twinning in Nickel. G. Menzer. *Naturwiss.* 26. pp. 385-387, June 17, 1938.—The author cites anomalous results, obtained by Brück for thin Ni and Ag films condensed on rock-salt, by electron diffraction photographs [see Abstract 2977 (1936)], and the claim of Royer [see Abstract 3261 (1935)] that the lattices of rock-salt ($a = 5.628 \text{ \AA}$), Ag ($a = 4.08 \text{ \AA}$) and Ni ($a = 3.52 \text{ \AA}$) lie parallel. Submicroscopic twinning has previously been postulated to explain the cases of SiC and felspar KAlSi_3O_8 . Further, Hull [see Abstract 380 (1918)] found a weak body-centred lattice in Ni, and electrolytic Ni or a condensed Ni film may show a hexagonal or tetragonal structure. The author discusses the effect of twinning on a minute scale with (111) planes moved in parallel directions, and concludes that not only the (001) line but also the (002), (004) and (008) maxima must disappear. New reflections may appear at $(\frac{1}{3} \frac{1}{3} \frac{1}{3})$, $(\frac{2}{3} \frac{2}{3} \frac{2}{3})$, etc., which may simulate an entirely new lattice, and to some extent this may occur even in powder photographs. He considers this phenomenon is sufficient to explain these anomalies, at least in part. D. R. H.

***3466. Lattice Constant of Silver at High Temperatures.** W. Hume-Rothery and P. W. Reynolds. *Roy. Soc., Proc.* 167A. pp. 25-34, July 7, 1938.—A camera for accurate high temperature work, with filings enclosed in a thin-walled SiO_2 capillary, thus avoiding volatilisation from the small quantity of heated metal on to the large area of camera wall *in vacuo*, is described. The special technique for handling such fine tubes is discussed critically. Assuming that the expansion of massive Ag is attributable solely to the lattice expansion, and using Keesom and Jansen's data for the former, the authors find that between -253°C . and 943°C .

$$\log_{10} \left(\frac{a}{a_0} \right) = \frac{c\theta}{\theta_0 - \theta} + x e^{-y\theta},$$

where $a_0 = 0.608079$, $c = 4.1614 \times 10^{-2}$, $\theta_0 = 5586.6$, $x = 0.0004898$, $y = 1.5208 \times 10^{-2}$. When $\theta = 0$ $da/d\theta = 0$, satisfying the theoretical condition of a zero coefficient at absolute zero. Above 273°K . the second term is less than $0.0001 \text{ \AA}$, so that the equation then reduces to a very simple form with only two constants. This simplified equation holds also for quartz. D. R. H.

3467. Structure of Thin Ni and Ag Films. G. Menzer. *Zeits. f. Krist.* 99. 5. pp. 5. pp. 410-443, 1938.—Brück [see Abstract 2977 (1936)] evaporated Ag and Ni on to the surface of rock-salt crystals and examined by electron diffraction the thin films so obtained. The present author makes an analysis of the photographs and deduces the laws governing the coalescence of the two lattices. He finds that the metal layers do not form a homogeneous lattice with symmetry axes parallel to those of the rock-salt but the adjacent parts of the two lattices form an intersecting lattice. The method by which these lattices are formed is examined. The author makes a similar analysis of photographs obtained by Cochrane [see Abstract 4473 (1936)] of Ni films deposited electrolytically on the (110) face of a Cu single crystal. J. I.

3468. Optical Constants, Electrical Resistance and Structure of Thin Metal Films. J. Krautkrämer. *Ann. d. Physik*, 32. 6. pp. 537-576, July, 1938.—Electrical resistance and optical constants were

determined for thin films of Au and Ag evaporated in high vacuum on to fused silica substrates at various temperatures, whilst the structure and roughness of the films was investigated by electron diffraction at grazing incidence. A comparison of the optical constants of the films deposited at high temperatures with the theoretically calculated values for a loosely built layer of normal metal grains gives good agreement. In the same way, the resistance measurements and especially the roughness determinations support the view that the properties of the investigated films are to be attributed not to an amorphous, but to a colloidal state of the metal, *i.e.*, the films consist of individual but normal crystallites. A. G. Q.

3469. Monotropy of Ice at Atmospheric Pressure (Ice VIII). E. Cohen and C. J. G. van der Horst. *Zeits. f. phys. Chem.* 40. Abt. B. 4. pp. 231–251, 1938.—By chemical and X-ray methods it is shown that at 1 atm. pressure water may crystallise regularly. The regular crystals are obtained from mixtures of water with organic liquids, especially acetone or propyl aldehyde. The regular modification, to which the name Ice VIII is given, is metastable at 1 atm. pressure. Its density at -30°C . is 0.105 ± 0.2 . Dilatometric and optical investigation of naturally occurring ice and of ice formed from water mixed with toluene, decahydronaphthalene and xylene shows the presence of small quantities of a regular form in addition to the hexagonal. L. A. W.

3470. α - β Transformation in Quartz. H. E. v. Steinwehr. *Zeits. f. Krist.* 99. 4. pp. 292–313, 1938.—The author describes experiments in which beams of light from the same source are made to pass through a quartz crystal in directions which are respectively perpendicular and parallel to the optic axis. The beams fall on to photographic plates and simultaneous photographs are taken during the $\alpha \rightleftharpoons \beta$ transformation over a temperature range of 4°C . The curves on the photographs resulting from the change of temperature show breaks which, the author concludes, prove the existence of two intermediate modifications. These modifications are probably biaxial. J. I.

3471. Variations of Crystalline Parameter of CdO by Insertion of Cd Atoms in its Lattice. R. Faivre and A. Michel. *Comptes Rendus*, 207. pp. 159–161, July 11, 1938.—An X-ray study has been made of variations in the structure of the products formed when mixtures of CdO and Cd are heated. The experiments indicate the existence of solid solutions in which Cd has been inserted within the oxide lattice. These results should explain the phenomena of O_2 absorption by various oxides such as those of Cd, Zn and Ni, and the anomalies in electrical conductivity which result therefrom. H. H. Ho.

3472. Reciprocal and Bravais Lattices of Axinite. W. F. de Jong. *Zeits. f. Krist.* 99. 4. pp. 326–335, 1938.—A spectrometer, described in a previous paper [see Abstract 1412 (1938)] has been constructed, and is now applied to an investigation of axinite. From two photographs the reciprocal lattice of the substance is determined. The elementary cell is $a = 7.13$, $b = 8.91$, $c = 9.14$, $\alpha = 91^{\circ}51'$, $\beta = 102^{\circ}52'$, $\gamma = 81^{\circ}57'$, and the density 3.17 gm. cm^{-3} . The reciprocal lattice is $a' = 8.91\text{ mm.}$, $b' = 6.96\text{ mm.}$, $c' = 6.89\text{ mm.}$, $\lambda = 89^{\circ}55'$, $\mu = 77^{\circ}16'$, $\gamma = 97^{\circ}50'8''$. (Cu K α radiation.) C. J. B. C.

3473. Polymorphism of MnSe. A. Baroni. *Zeits. f. Krist.* 99. 4. pp. 336–339, 1938.—From an electron diffraction study it is established that MnSe may exist in three different forms, as Schnaase has shown for MnS, MnSe α obtained by the ageing of the MnSe precipitated from a

sulphate, chloride or acetate solution by $(\text{NH}_4)_2\text{Se}$, has an NaCl type of structure, $a = 5.44 \text{ \AA}$. $\text{MnSe}\beta$ is prepared by keeping a solution of manganese acetate for some hours in contact with an atmosphere of H_2Se . This modification has a ZnS type of structure with edge $5.82 \text{ \AA}$. This form passes over into the α -form. $\text{MnSe}\gamma$ is very unstable. It is formed by the action of H_2Se and gaseous ammonia on a boiling MnCl_2 or MnSO_4 solution. It crystallises with a wurzite lattice, $a = 4.12$, $c = 6.72$.

C. J. B. C.

3474. Structure of EuS. W. Nowacki. *Zeits. f. Krist.* 99. 4. pp. 339-341, 1938.—The unit cell of EuS, determined by the powder method, is probably face-centred cubic, $a = 5.957 \pm 0.002 \text{ \AA}$. It is not possible to give the space group with any certainty but it is probably one of the following, $\text{O}_h^5\text{-Fm}3\text{m}$, $\text{O}^3\text{-F}43$, $\text{T}_d^3\text{-F}43\text{m}$, $\text{T}_h^3\text{-F}_m^3$ or $\text{T}^2\text{-F}23$. There are 4 molecules in the unit cell and the density is 5.884 gm cm^{-3} . The ionic radius is found to be $1.24 \text{ \AA}$ and the atomic volume 29.0 .

C. J. B. C.

3475. Structure of Bismuth Trioxide. L. G. Sillén. *Arkiv f. Kem. Min. och Geologie, Stockholm*, 12A. 18. [15 pp.], 1938. *In English*.—Various apparently different phases of Bi_2O_3 were examined with X-rays: $\alpha\text{-Bi}_2\text{O}_3$, stable at the ordinary temperature, originally regarded as orthorhombic, is shown to be monoclinic with $a \ 5.83$, $b \ 8.14$, $c \ 7.48$, $\beta \ 67^\circ.07$, and $4\text{Bi}_2\text{O}_3$ in the unit cell, space group probably C_2^1 or C_2^2 ; $\beta\text{-Bi}_2\text{O}_3$, stable at high temperature, tetragonal (pseudocubic, perhaps truly cubic at high temperature) corresponds with the cubic forms of As_2O_3 and Sb_2O_3 , $a \ 5.525$, with $4\text{Bi}_2\text{O}_3$ in the unit cell; retention of the cubic structure at low temperature may perhaps be due to contamination with SiO_2 ; Bi_2O_3 fused with a little Al_2O_3 or Fe_2O_3 gives a body-centred cubic phase with $a \ 10.08$, and $12\text{Bi}_2\text{O}_3$ in unit cell space group probably T_3 ; this phase is, however, perhaps really $12\text{Bi}_2\text{O}_3 + \text{Me}_2\text{O}_3$ ($\text{Me} = \text{Al}$ or Fe); possible structures for both are proposed.

C. A. S.

3476. Structure of $\text{CuCl}_4 \cdot 2\text{NH}_3 \cdot (\text{NH}_4)_2$. A. Silberstein. *Comptes Rendus*, 206. pp. 1737-1739, June 8, 1938.—Debye-Scherrer photographs are taken of the above compound and from the close similarity between them and photographs of $\text{CuCl}_4 \cdot 2\text{H}_2\text{O} \cdot (\text{NH}_4)_2$ the author obtains the structure. The cell is tetragonal with the following dimensions $a = b = 7.74 \text{ \AA}$, $c = 8.84 \text{ \AA}$, $c/a = 1.023$; d (calc.) $= 1.92$, d (obs.) $= 1.92$. Good agreement is obtained between estimated intensities and those calculated on the assumption that $1/3$ of the Cu atoms are arranged regularly in the lattice and the other $2/3$ arranged irregularly. [See Abstract 2680 (1938).]

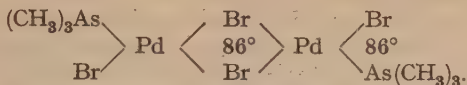
J. I.

3477. Structure of Trimethylstibine Dihalides $(\text{CH}_3)_3\text{SbX}_2$. A. F. Wells. *Zeits. f. Krist.* 99. 5. pp. 367-377, 1938.—The structure of the compounds $(\text{CH}_3)_3\text{SbX}_2$ (where $\text{X} = \text{Cl}$, Br or I) is investigated by means of X-rays. They all crystallise in the hexagonal system with the following unit cell dimensions, $\text{X} = \text{Cl}$, $a = 7.27$, $c = 8.44 \text{ \AA}$; $\text{X} = \text{Br}$, $a = 7.38$, $c = 8.90 \text{ \AA}$; $\text{X} = \text{I}$, $a = 7.53$, $c = 9.59 \text{ \AA}$; space group $= \text{C}_{6h}2\text{c}$. The following bond distances are evaluated from estimated intensities of reflection, $\text{Sb} - \text{Cl} = 2.49$, $\text{Sb} - \text{Br} = 2.63$, $\text{Sb} - \text{I} = 2.88 \text{ \AA}$. These distances are considerably greater than those found by electron diffraction in the trihalides (SbX_3). The compounds are therefore regarded as being intermediate between (a) the 5-covalent molecule $(\text{CH}_3)_3\text{SbX}_2$, in which the halogen atoms are symmetrically disposed on opposite sides of a planar $\text{Sb}(\text{CH}_3)_3$ group, and (b) the ionic form $\text{X}^-[\text{Sb}(\text{CH}_3)_3]^{2+}\text{X}^-$.

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This interpretation is in accord with the abnormal physical and chemical properties of these compounds. J. I.

3478. Structure of Bridged Palladium Compounds. A. F. Wells. *Roy. Soc., Proc.* 167A. pp. 169-189, Aug. 5, 1938.—The crystal structures of the bridged compounds $[(CH_3)_3As]_2Pd_2Cl_4$ and its Br analogue have been determined. The crystals of the tetrachloride from alcohol and from dioxane and those of the tetrabromide from dioxane are all isomorphous. A probable structure deduced from the optical properties, cell dimensions and symmetry was confirmed by Fourier projections using visually estimated intensities. The structure of the tetrabromide was investigated in detail, the configuration of the molecule being finally obtained from a section of the three-dimensional electron density distribution. The bridged molecule is found to be planar with the configuration :



The interatomic distances are : Pd-Br, 2.45 and Pd-As, 2.50 ± 0.05 Å. The molecules are stacked in columns along 4_2 axes in the space group $I 4/m$, and the columns of molecules are held together by very weak van der Waals forces. The packing of the molecules in this way leaves tunnels through the structure. These remain empty in certain circumstances, as for example when the tetrachloride crystallises from alcohol. On crystallising from dioxane, however, this compound takes up dioxane of crystallisation presumably owing to the fact that the diameter of the dioxane molecules is approximately the same as that of the holes in the structure. The introduction of the solvent is accompanied by a small increase in the cell size and a slight reorientation of the molecules of the Pd compound. AUTHOR.

3479. Structures of 9:10-Dihydroanthracene and 9:10-Dihydro-1:2:5:6-Dibenzanthracene. J. Iball. *Chem. Soc., J.* pp. 1074-1077, July, 1938.—The crystal structures of 9:10-dihydroanthracene and 9:10-dihydro-1:2:5:6-dibenzanthracene have been investigated by X-rays. The latter compound crystallises in two distinct monoclinic modifications, and in one of them it is possible to demonstrate the presence in the molecule of a centre of symmetry. If it is assumed that the two naphthalene nuclei are planar, it follows that the whole molecule must be planar, as it possesses a centre of symmetry. AUTHOR.

3480. Structure of Diketopiperazine. R. B. Corey. *Am. Chem. Soc., J.* 60. pp. 1598-1604, July, 1938.—X-Ray examination of crystals of 2,5-diketopiperazine shows them to be built upon a simple monoclinic unit having $a_0 = 5.19$ Å, $b_0 = 11.50$ Å, $c_0 = 3.96$ Å, and $\beta = 83^\circ$, containing two molecules. All atoms are in the general positions of the space group $C_2^5h - P2_1/a$ with the following parameters : O, $x = 0.160$, $y = 0.368$, $z = 0.885$; C, $x = 0.320$, $y = 0.430$, $z = 0.705$; methylene C, $x = 0.545$, $y = 0.380$, $z = 0.495$; N, $x = 0.280$, $y = 0.544$, $z = 0.695$. The molecule is a nearly flat hexagonal ring possessing a centre of symmetry, the angles between all bonds being $120 \pm 3^\circ$. The interatomic distances within the molecule are : C-O 1.25 Å, C-C 1.47 Å; C-N 1.33 Å and N-methylene C 1.41 Å, each ± 0.03 Å. All molecules are held together by H bonds to form long, parallel chains throughout the crystal. Packing of the molecules is discussed. AUTHOR.

3481. Structure of Anthraquinone. B. C. Guha. *Phil. Mag.* 26. pp. 213-223, Aug., 1938.—The arrangement of the atoms in the anthraquinone crystal has been determined by the trial and error method. It has been found that the C atoms are all in one plane, and the C plane is tilted from the (001) plane by 6° about each of the "a," "b," and "c" axes. The hexagons deviate slightly from regularity; the side rings have all the internal angles equal to 120° , but the lengths of sides are alternately $1.35 \text{ \AA}$ and $1.46 \text{ \AA}$. For the middle ring the internal angles differ from 120° ; the angle between the two single bonds is 109° , and that between a single bond and a double bond is 125° . The C—C bonds are $1.46 \text{ \AA}$ and the C=C bonds are $1.35 \text{ \AA}$, as in the outer rings. The O atoms are inclined to the carbon plane unsymmetrically, the C=O distances being $1.13 \text{ \AA}$ each. AUTHOR.

3482. Space-Group of Creatinine. K. Banerjee and A. Haque. *Indian Journ. Phys.* 12. pp. 183-194, May, 1938.—The cell dimensions of creatinine have been determined by the rotation photograph method with results, $a_0=14.86$, $b_0=13.14$, $c_0=5.85 \text{ \AA}$ and $\beta=110^\circ 36'$. The number of molecules per unit cell is thus calculated to be 8. From oscillation photographs it is concluded that no systematic absence of planes occurs and hence the space-group is found to be $C_{2h}^1/P_2/m$. AUTHORS.

3483. Quasi-Crystalline and Crystalline Liquids. F. C. Frank. *Phys. Zeits.* 39. pp. 530-534, July 1, 1938.—This paper deals with certain difficulties which arise in the attempt to render compatible the theory of quasi-crystalline structure in normal liquids with the existence of true crystalline liquids. It is shown by means of known forces that two non-adjacent molecules can only be parallel when a chain of adjacent parallel molecules lies between. Such a chain can break, continue, or branch at any point, so that it is of fundamental importance for the extension of the parallelism that the relationship of the probabilities of branching and scission be known. If the ratio be less than unity, then the parallelism is limited to a finite region, but if equal to unity then it is unlimited. In this relationship, that varying molecular ratios may produce variable macroscopic transformations, is to be found the solution to many problems in the theory of crystalline structure in liquid phases, especially from the data of the X-ray spectra which indicate that the liquid and liquid crystal forms are almost identical. The consideration of small deviations from parallelism in every chain member, which are reduced in multiple chain compounds, is necessary for the explanation of thermal transformations and other variable transitions by this theory.

H. H. Ho.

3484. Effect of Temperature on Atomic Distribution in Liquid Potassium. C. D. Thomas and N. S. Gingrich. *J. Chem. Phys.* 6. pp. 411-415, Aug., 1938.—X-ray diffraction patterns of liquid K at temperatures of 70° , 200° , 295° and 395° C. have been obtained, using Mo K α radiation. Three peaks appear in each pattern, and with increasing temperature the peaks become somewhat less pronounced. The first and most intense peak appears at a scattering angle of $10^\circ 36'$ in the 70° C. case, and it appears at $10^\circ 16'$ in the 395° C. case. Fourier analysis applied to the above two cases gives the atomic distributions at these temperatures. In the 70° C. distribution curve, the maximum of the first peak occurs at $4.64 \text{ \AA}$, that of the second peak at $9.0 \text{ \AA}$, and after this the distribution rapidly becomes random. In the 395° C. distribution curve, the maximum of the first peak occurs at $4.8 \text{ \AA}$, that of the second

at $9.2 \text{ \AA}$, and beyond this the distribution becomes random more rapidly than in the 70°C . case.

AUTHORS.

3485. Crystallisation of Alkali Halogen Salts on Fluorite. L. Krastanow and I. N. Stranski. *Zeits. f. Krist.* 99. 5. pp. 444-448, 1938.—Experiments are described in which halogen salts of the alkali metals are deposited on to the octahedral face of CaF_2 crystals. The degree of orientation varies according to whether the lattice constant of the deposited salt is similar or not to that of CaF_2 ($d=5.47 \text{ \AA}$). NaCl ($d=5.62 \text{ \AA}$) shows very good orientation while KI ($d=7.11 \text{ \AA}$) shows no orientation. The authors discuss the theory of the crystal growth.

J. I.

See also Abstracts 3442, 3451, 3454, 3500, 3678, 3762, 3809, 3810, 3825, 3845, 3847.

DENSITY.

3486. Limiting Densities of O_2 and CO_2 . Atomic Weight of Carbon. E. Moles and A. Escribano. *Comptes Rendus*, 207. pp. 66-68, July 4, 1938.—The densities of O_2 and CO_2 under 760 mm. and 380 mm. pressure have been determined by adsorbing known volumes of the gases on activated charcoal and finding the increase in weight. The limiting densities obtained by extrapolation were: O_2 , 1.427644 gm./l. ; CO_2 , 1.963340 gm./l. This gives 44.0074 for the molecular weight of CO_2 , and 12.0074 for the atomic weight of C.

A. J. M.

3487. Densities of NaCl and KCl Solutions at 0°C . T. Batuecas. *Zeits. f. phys. Chem.* 182. Abt.A. 3. pp. 167-176, 1938.—Density determination at 0°C were made by the author's pyknometer method with a view to investigating the validity of the Marson-Geffcken-Redlich linear relation between the apparent molar volume and the square-root of the concentration. It is confirmed that the relation is linear for solutions of strength 0.5 to 0.2 N . In agreement with Geffcken, below 0.2 N it was found that there is noticeable curvature which in the lower region has the form of a flat S curve. The experimental method was not suitable for observations below 0.02 N . By least square extrapolation to zero, values were found for the molar volumes which are in good agreement with those of Redlich and Rosenfeld.

P. H. B.

3488. Density of Solutions of Organic Acids in Benzol, Dioxane and Cyclohexane. G. Schulz. *Zeits. f. phys. Chem.* 40. Abt.B. 3. pp. 151-157, 1938.—The densities at 20°C of solutions of cinnamic, lauric, benzoic and propionic acids in benzol and dioxane, and of lauric and propionic acids in cyclohexane, were determined by sinker weighings. Except in the case of propionic acid the results were consistent to within 0.00001 . The density-concentration curves are however not smooth but show slight local deformations. From a comparison of the curves it is concluded that the solvents play an important part in the formation of "solution-complexes".

P. H. B.

3489. Densities of D_2O and H_2O . Electrolytic Separation of Oxygen Isotopes. L. Tronstad and J. Brun. *Faraday Soc., Trans.* 34. pp. 766-773, June, 1938.— 100% D_2O and 100% H_2O of the same oxygen isotopic ratio as in air have been prepared by the reaction of 100% D_2 and H_2 , made by electrolysis of large quantities of 99.5% heavy water and of natural water, with copper oxide. Precision determinations of the density at 20°C . referred to ordinary water of the same temperature give the figures: For D_2O : $d_{20}^{20}=1.10726 \pm 0.00001$, for H_2O : $d_{20}^{20}=0.999980 \pm 1 \text{ p.p.m.}$ These values correspond to a molecular abundance

of D_2O in natural water of : 1 : 5960 ± 300 , or by weight : 1 : 5360 ± 270 . Attention is drawn to the application of the 100% H_2O free from D_2 and of the same O^{18}/O^{16} -ratio as in air, as a reference substance in accurate work. The electrolytic separation factor of the oxygen isotopes is found to be $\alpha = 1.036$. The amount of O^{18} in the commercial heavy water from Norsk Hydro-Elektrisk Kvælstof A/S corresponds to 0.32% D_2O^{18} .

AUTHORS.

3490. Density of Tap-Water from Osaka, Japan, and Cambridge, U.S.A. T. Titani and N. Morita. *Chem. Soc. Japan, Bull.* 13. pp. 409-418, June, 1938. *In German*.—Comparisons were made between the densities of purified tap-water from Osaka (Japan) and Cambridge (U.S.A.) by means of sinker weighings. Repeat determinations on the Osaka water were consistent to $\pm 1 \times 10^{-7}$ gm./ml. and the results agreed with those for the Cambridge water to $\pm 2 \times 10^{-7}$ gm./ml. In comparing the results account was taken of isotopic fractionation by distillation and of the effect of dissolved air. P. H. B.

3491. Isotopic Ratio in Ordinary Water. N. Morita and T. Titani. *Chem. Soc. Japan, Bull.* 13. pp. 419-426, June, 1938. *In German*.—The D content of Osaka and Cambridge (U.S.A.) tap-water were determined by the production of D-free water. Water from both sources gave the same result, namely $D : H = 6200 \pm 200$. These values are compared with other published data, including the authors' earlier result [see Abstract 3977 (1936)]. P. H. B.

See also Abstract 3443.

DIFFUSION AND OSMOSIS.

3492. Diffusion in Metals. P. Chevenard and A. Portevin. *Comptes Rendus*, 207. pp. 71-73, July 4, 1938.—A review of methods, direct and indirect, of investigating metallic diffusion. A. J. M.

3493. Hydrogen Penetration Through Mercury. J. Nikliborc. *Acta Physica Polonica*, 7. 1. pp. 34-44, 1938. *In German*.—The mechanism of H_2 penetration through a column of Hg during the glow discharge between Hg electrodes in a mixture of Hg vapour and H_2 has been studied by an optical and by an electrolytic method. The penetration occurs principally by volume diffusion and the diffusion velocity is considerably influenced by convection currents in the liquid Hg and by the type of heating. The process involves essentially solution of HgH formed during the discharge. W. R. A.

3494. Separation of Gaseous Mixtures by Diffusion. E. H. Riesenfeld and T. L. Chang. *Arkiv f. Kem. Min. och Geologie, Stockholm*, 12A. 19. [8 pp.] 1938. *In German*.—The separation of a CO_2 - O_2 mixture by diffusion in a Hertz apparatus using porous tubes has been investigated. With increasing concentration of the heavy component the separation factor decreased. There is a logarithmic connection between the separation factor and the concentration of CO_2 . These results are discussed on the basis of the adsorption of the gases on the porous material. A. J. M.

3495. Self-Diffusion in Solids. G. Hevesy. *Faraday Soc., Trans.* 34. pp. 841-845; *Disc.*, 849-850, Aug., 1938.—A review of the application of the isotopic indicator method to the investigation of self-diffusion in metals and solid electrolytes. A. J. M.

3496. Self-Diffusion Coefficient of Gold. H. A. C. McKay. *Faraday Soc., Trans.* 34. pp. 845-849; *Disc.*, 849-850, Aug., 1938.—

The self-diffusion coefficient D of Au has been determined by finding at various temperatures the distribution of radioactive Au atoms in a disc of the metal after heating, the active atoms being originally more concentrated on one side of the disc than the other. The radioactive Au atoms were produced by bombardment of the disc with neutrons. The curve of $\log D$ against $1/T$ is linear. The connection between D and T is given by $\log D = 4.1 - 1.1 \times 10^4 \times 1/T$ (D in mm.^2 per min.) corresponding to a "heat of activation" of 51,000 cal. A. J. M.

3497. Osmosis. E. Ernst and J. Koczás. *Zeits. f. Physik*, 109. 9-10. pp. 625-641, 1938.—The authors claim to show both theoretically and experimentally that osmotic phenomena cannot be explained from a consideration of the kinetics of the dissolved substance (the non-permeable part of the solution), but are connected with the vapour pressure difference which the solvent (the permeable part) exhibits on the two sides of the membrane. From this standpoint, the conclusion is drawn (and experimentally verified) that in an osmotic system which on both sides of the membrane consists of solutions of equal concentration but at different temperatures—and in contrast to the deductions of classical theory—the solvent on the warmer side can flow to the colder solvent and thereby dilute it. From a consideration of this liquid transport—which is opposed to the concentration gradient produced by the thermal difference—there is offered a possibility of elucidating water phenomena in biological systems which hitherto have defied explanation. H. H. Ho.

See also Abstract 3791.

ELASTICITY AND PLASTICITY.

3498. Parallel Plate Calculations. C. V. Brigatti. *Ricerche di Ingegneria*, 6. pp. 42-47, March-April, 1938.—The method of H. Marcus is applied for the calculation of elastic plates with the form of a parallelogram supported and uniformly loaded. The results obtained are extended in particular to the rhombic plate for which is also calculated the case of the perfect dovetail with uniformly distributed load. J. J. S.

3499. Direct Determination of Stresses from Stress Equations. B. Sen. *Phil. Mag.* 26. pp. 98-119, July, 1938.—Problems of plane deformation have been solved without the help of Airy's stress function. The solution of corresponding plane stress problems can be deduced by substituting $(1+\sigma)^{-1}$ for $(1-\sigma)$ in the results obtained. The knowledge of the displacement is found to be unessential except in some special cases where the stresses cannot be directly determined from the stress equations, but where the complete solution is obtained on making the displacement single-valued with the addition of extra terms. The method now given has the advantage that the prescribed boundary values of the stresses being known, the stresses can easily be determined in most cases from the stress equations. H. H. Ho.

3500. Variation of Elastic Constants of Crystalline Sodium with Temperature Between 80° K and 210° K. S. L. Quimby and S. Siegel. *Phys. Rev.* 54. pp. 293-299, Aug. 15, 1938.—Methods are described for growing single crystals of Na in the form of rods 4.7 mm. in dia. and 10 cm. long, for handling the crystals in an atmosphere of He, and for measuring the principal elastic moduli at low temperatures. Values of the adiabatic and isothermal moduli and constants are tabulated at ten degree intervals between 80° K. and 210° K. The value of the

Debye characteristic temperature, calculated from the values of the elastic constants at 80° K, is 164° K. AUTHORS.

3501. Elastic Effect in Vulcanised Rubber. W. Braunbek. *Zeits. f. Physik*, 109. 7-8. pp. 510-516, 1938.—In the theory of elasticity Hooke's law is only a first approximation, the terms of second and higher orders being neglected. A consideration of terms of the second order demands the introduction of a new elastic constant (the "s" of Poynting). Torsional measurements on loaded rubber tubing give a constant (C) of the order of 10^{-1} , a value which is about 10 times smaller than in metals; thus, under identical conditions, the lengthening of a rubber tube under torsion is smaller than in metals. The value of C depends to a large degree on the nature of the rubber. H. J. H. S.

3502. Optical Method for the Determination of Variable Elastic Stresses. B. Ferretti. *N. Cimento*, 15. pp. 77-87, Feb., 1938.—It is shown that the sum of the principal stresses in a plane lamina can be determined experimentally for any material by photoelastic measurements in the general case when the stresses are varying with time. A photoelastic method for measuring rapidly variable stresses is described which gives both the values and the directions of the stresses from instant to instant. The method is applied to the case of a plate of glass subjected to a sudden blow. W. S. S.

***3503. Elastic After-Effect. Part II.** Schlötzer. *Zeits. f. Instrumentenk.* 58. pp. 264-270, July, 1938.—Continuing the experimental investigation on elastic after-effect by means of two clock springs [see Abstract 4334 (1937)], it is found that if the same springs are subjected to special mechanical or electrical ageing treatment after a large change of tension takes place, the elastic after-effect is reduced to less than half that which occurs when no artificial ageing is applied. H. B.

3504. Mechanical and Thermal Treatment of Synthetic Resins. S. Erk and W. Holzmüller. *Phys. Zeits.* 39. pp. 535-540, July 15, 1938. *From the Reichsanstalt.*—The hardness of synthetic resins is measured by a ball indentation hardness tester and it is found that considerable plastic deformation is induced by the ball, the size of the indentation becoming less after the load is removed. Mechanical and optical tests show that when the ball impression is formed internal strains are induced which may be removed by heating at temperatures up to about 100° C. At higher temperatures there is a continuous softening for some synthetic resins but in the case of others an increase of hardness sets in at temperatures higher than 160°-250° C. J. T.

See also Abstracts 3442, 3523, 3563, 3604, 3859, and

- 2584B. Internal Shearing Stress in Cold-Twisted Metallic Bars. T. Uéda.
2588B. Photoelastic Analysis. O. J. Horger.
2589B. Phenolformaldehyde as Photoelastic Material. A. Kuske.

GRAVITATION.

3505. Thickness of the Isostatic Earth's Crust. C. Tsuboi. *Tokyo Univ. Earthquake Research Inst., Bull.* 16. pp. 285-287, June, 1938. *In English.*—Using a double Fourier series for the surface topography of the area in question, and the Bouguer anomalies in this area, an expression is obtained for the depth, d , at which the load of the surface mass is compensated. The value of d can be calculated directly from surface gravities and topographies. To get the thickness of the isostatic earth's crust, which corresponds to zero height, the thickness of the mass

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compensating the constant term of the topography must be subtracted from d . Tests show satisfactory results from the method. R. S. R.

See also Abstract 3540.

HYDRODYNAMICS AND AERODYNAMICS.

***3506. Non-Static Problems in Hydrodynamics.** G. Krall. *Ricerca Scientifica*, 9. pp. 445-474, May, 1938.—The paper deals with wing problems, including vibrating and beating wings and questions of critical velocity. In an appendix a new design for a wind tunnel, adapted for the study of oscillating wings and for the recovery of the vortices of Prandtl and Birnbaum, is described. W. A. R.

3507. Air Movements with Very Low Reynolds Numbers. J. Luneau. *Comptes Rendus*, 206. pp. 1788-1790, June 13, 1938.—Having already in a preceding investigation [see Abstract 1026 (1937)] considered air resistance for high Reynolds numbers, the author has now investigated the effect of low numbers. The coefficient of resistance becomes inversely proportional to these numbers, and the resistance to movement proportional to the amplitude. W. A. R.

3508. Efficiency of Air-Screws. R. Esnault-Pelterie. *Comptes Rendus*, 207. pp. 13-17, July 4, 1938.—The author discriminates between the coefficient of kinematic utilisation and the aerodynamic efficiency of an air-screw, and points out that under certain conditions it would appear to be advantageous to increase the number of blades on the air-screw. J. S. G. T.

3509. Propagation of Hydraulic Waves. G. Krall. *Accad. Lincei, Atti*, 27. pp. 348-356, April 3, 1938.—This paper deals mathematically with the propagation of waves and the transmission of energy in a hydraulic system. The following cases are considered in some detail: when the various pipes forming the system meet in a common node and the compression begins in one of them and is reflected at the ends of the others; a single pipe, the compression beginning at one end, the other end being closed by a vibrating system; the pipe along which the compression travels is of various characteristics—varying diameter—the compression being started at one end and the other end leading into a large reservoir; the pipe, constant in diameter, has a large reservoir or capacity part way along its length, at one end the compression originates and the end leads into another reservoir. G. G.

3510. Equations of Probable Values of Turbulent Fluids. G. Dedebant and P. Wehrle. *Comptes Rendus*, 206. pp. 1790-1792, June 13, 1938.—The author arrives at a generalisation of classical hydrodynamical theory of viscous fluids by the introduction of turbulent energy analogous to the generalisation of rational mechanics by the introduction of calorific energy. W. A. R.

3511. Velocity and Temperature Distributions in the Turbulent Wake behind a Heated Body of Revolution. A. A. Hall and G. S. Hislop. *Cambridge Phil. Soc., Proc.* 34. pp. 345-350, July, 1938.—Recently [see Abstract 954 (1938)] Goldstein made calculations based on theories of vorticity transfer, of the distributions of velocity and temperature in the turbulent wake behind a heated body of revolution, and the present authors now record an experimental determination of these distributions in a low-turbulence wind tunnel. Difficulty was experienced in obtaining a truly symmetrical wake, and observations

have been reduced to mean values, curves of which are given. [See following Abstract.]

H. H. Ho.

3512. Velocity and Temperature Distributions behind a Heated Body of Revolution. S. Goldstein. *Cambridge Phil. Soc., Proc.* 34. pp. 351-353, July, 1938.—The measurements of Hall and Hislop [see preceding Abstract] are compared with the results of a mathematical analysis, and the theoretical curves on the momentum transfer theory and on the modified vorticity transfer theory are found to be practically identical over the inner part of the wake. They are not in agreement in the outer parts of the wake, but here it was known that the theory must lead to incorrect results. It is concluded that though Kármán's "similarity" theory may lead to an equation of the same form as either the momentum or the vorticity transfer theories with symmetrical turbulence, it cannot lead to an equation of the same form as the modified vorticity transfer theory and therefore must give unsatisfactory results in a symmetrical wake.

H. H. Ho.

3513. Stability of a Viscous Liquid between Rotating Coaxial Cylinders. J. L. Synge. *Roy. Soc., Proc.* 167A. pp. 250-256, Aug. 5, 1938.—The differential equations of the characteristic-value problem for the small disturbance of a viscous liquid contained between two rotating coaxial cylinders are put into convenient form. From these is deduced an expression for the real part of the characteristic number σ occurring in an exponential time factor, the expression involving integrals in which the integrands contain the product of a characteristic function or one of its derivatives by the complex conjugate. If the circulation at the outer cylinder is greater than that at the inner cylinder and has the same sign ($\omega_2 r_2^2 > \omega_1 r_1^2 > 0$), the signs of these integrals are known without knowledge of the characteristic functions, and it is found that the steady motion is stable under the condition stated. Unlike the work of G. I. Taylor on this problem, the present theory involves no approximations based on the thinness of the layer of liquid, but (as in Taylor's work) the only disturbances considered are those which are independent of the azimuthal angle and periodic in the direction of the generators of the cylinders. AUTHOR.

3514. Experimental Realisation of Solid Boundaries Free from Limiting Layer. A. Toussaint and M. Gdaliahu. *Comptes Rendus*, 207. pp. 117-118, July 11, 1938.—The presence of a limiting layer at the solid boundary of a conduit in which fluid flows is avoided by making the boundary wall of perforated iron sheet covered with permeable silk. Air or other fluid is aspirated through the silk.

J. S. G. T.

3515. Hydraulic Régime when a Solid is Translated through a Viscous Liquid. R. Serville. *Comptes Rendus*, 206. pp. 1947-1948, June 27, 1938.—A crystal of fuchsine is attached to a solid which is then allowed to fall freely in a stream of water. Below the critical velocity the dye is discharged in parallel lines; with higher velocities disturbances occur which can be classified into four types.

W. A. R.

3516. Pressure Losses for Fluid Flow in 90° Pipe Bends. K. H. Beij. *Bureau of Standards, J. of Research*, 21. pp. 1-18, July, 1938.—Pressure losses were determined for nine 4-in. steel, 90° pipe bends of radii from 6 to 80 in. The results are discussed in relation to those found by previous investigators under comparable test conditions. For bends having radii of four pipe diameters or less, all the results which are discussed may be correlated on the basis of pipe roughness. Further data are needed to establish a working formula. No correlation could be ob-

tained for the bends of larger radii. For such bends the maximum published values should be used in engineering work until more comprehensive data become available.

AUTHOR.

See also Abstracts 3536, 3764, 3765.

KINETIC THEORY OF MATTER.

3517. Kinetic Processes in Boundary Surfaces. K. Neumann. *Zeits. f. Elektrochem.* 44. pp. 474-478, Aug., 1938.—The uniform distribution of a solute in a solution is brought about by diffusion processes, and in analogous manner the concentration equilibrium in single adsorption layers is produced and maintained by kinetic processes the mechanism of which forms the subject of the present paper. The spreading of liquid surface films on a liquid substratum, e.g., oil on water, is first considered at length, and the rapid rates of solution of such substances as camphor and water or benzophenone and mercury are ascribed to the rapid movements of the surface molecules. The significance of surface kinetics for condensation and evaporation processes at solid bodies is next discussed in detail. Finally the movements of polar molecules on ionic lattices are examined. 5 diagrams and 13 references are included in the papers. H. H. Ho.

3518. Relativistic Degenerate Gas and its Application to Brownian Motion. M. Satô. *Tôhoku Univ., Sci. Reports*, 11. pp. 429-432, April, 1938. In German.—In a previous paper [see Abstract 2545 (1936)] the author has theoretically investigated the Brownian movement of a particle in a radiation field, whereby the particle is assumed to receive an impulse-charge by the irregular impacts of light quanta. This theory is now supplemented by a discussion of the Einstein fundamental conception of impulse-fluctuation within empty space radiation; the physical significance of the photo-cause of the Brownian movement is thereby explained. H. H. Ho.

See also Abstracts 3497, 3779.

LENGTH, AREA AND VOLUME.

See Abstract 3579.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

3519. Effect of Departures from Ideal Conditions other than Non-Normality on the t and z Tests of Significance. H. E. Daniels. *Cambridge Phil. Soc., Proc.* 34. pp. 321-328, July, 1938.—It is shown that slight departures from independence and equal weight of the sample observations introduce a bias into Fisher's z , but that the distributions of the variances "within and between groups", and of Fisher's z would appear to maintain their form to the first order, although the extent to which the approximations hold in practice has not been considered. AUTHOR.

3520. Fluctuations and the Shot Effect. E. N. Rowland. *Cambridge Phil. Soc., Proc.* 34. pp. 329-334, July, 1938.—In view of a criticism [see Abstract 4956 (1937)] of a proof and extension of Campbell's theorem on fluctuations previously reported [see Abstract 495 (1937)], certain parts of the proof are amplified and further explanations of the foundations of the theory are given. N. M. B.

3521. Short Derivation of a Fundamental Probability Formula. L. Silberstein. *Phil. Mag.* 26. pp. 223-224, Aug., 1938.

3522. Dimensions in Continuum Physics. R. Fürth. *Ann. d. Physik*, 32. 4. pp. 336-346, June, 1938.—For continuum physics it is
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assumed that there exists a "homogeneous body," *i.e.*, one possessing no structure. The physical behaviour of such a body is expressed by differential equations between the observable physical magnitudes, the coordinates and the time; yet in these certain "material constants" are still contained, which for each body composed of the same material must have the same value independent of its form and magnitude. The question arises whether such a system can be employed as expression of a continuum theory, *i.e.*, whether the therein contained material constants indicate a homogeneous body or whether for the understanding of the phenomena which are observed a hidden spatial or temporal structure must be assumed. These and similar questions are discussed, the views of various authors being mentioned, and the different departments of physics severally considered. In particular Zöcher's theory which is described as a "pseudo-continuum theory" is dealt with. Zöcher brought forward his theory in connection with the elastic behaviour of liquid crystals. The author himself prefers a dimension criterium which he explains in the paper.

J. J. S.

See also Abstracts 3535, 3579, 3778, 3832, 3881.

MECHANICS, CLASSICAL.

3523. Mechanics of Elastic Bodies. C. Cattaneo. *Accad. Lincei, Atti*, 27. pp. 342-348, April 3, 1938.—This paper deals with the local stresses set up in a small zone around the region of contact when two elastic bodies collide, the collision being an oblique one. The effect of friction is taken into consideration. Comparatively simple equations are obtained for the distribution of the stresses in the case where the bodies are of the same material. These equations will give a first approximation, using modified constants of course, even in the case where the two bodies are made of different materials.

G. G.

3524. Flight of Projectile. R. H. Kent. *Frank. Inst., J.* 226. pp. 19-23, July, 1938.—A popular review of the internal and external ballistics of the flight of a projectile from gun to target. The review gives all the latest results and methods of measurement in a simple manner.

S. G. B.

***3525. Dissipation of Energy by a Pendulum Swinging in Air.** E. C. Atkinson. *Phys. Soc., Proc.* 50. pp. 721-741; *Disc.*, 753-756 and 856-857, Sept. 1, 1938.—The decrement of a pendulum falls slowly with the amplitude: hence the need for determinations based on small changes of angle. The resulting errors of observation lead to erratic values but not to systematic error. The result of measurements with a seconds pendulum enclosed in a case is shown by a smoothed curve, the departure from observed times being expressed by *smoothing fractions*, and a *smoothing figure* is a measure of this departure for the whole or part of the experiment. From the decrement the rate of loss of energy is calculated. This 7 kg. pendulum with amplitude 53' dissipates a Board of Trade Unit (which serves a 70 W. lamp for 14 hr.) in rather over 100,000 years. Experiments with different pendulums are described by which the component losses due to suspension, rod, and bob are found. Suspension springs made from thin strip clamped in chaps dissipate large and variable amounts of energy compared with springs made from thick strip ground thin in the middle. The variable losses are associated with variable rates of the pendulum. The cylindrical case adds considerably to the air resistance. The measured loss due to a

gravity impulse lever is little in excess of the computed loss from collision with the pendulum: for a seconds pendulum $1/2000$ part of the free pendulum loss.

AUTHOR.

***3526. Amplitude Deviation of Rate of a Pendulum. E. C. Atkinson.** *Phys. Soc., Proc.* 50. pp. 742-756, Sept. 1, 1938.—In a previous experiment [see Abstract 3030 (1936)] the amplitude deviation was almost equal to the circular deviation. The present experiment was made on a lighter pendulum with a long suspension spring, moving in different surroundings. The amplitudes ranged from 108' to 224' as compared with the previous range of 30' to 70'. The deviation is about 15% larger than the circular deviation and is well represented by the latter plus a linear term. Two other experiments with Graham's escapement are referred to, in which the driving weights are varied. One of these, described by Cunynghame, seems to be hypothetical, for it yields an amplitude giving a minimum rate instead of a maximum one. Guillaume overlooked the large temperature effect produced by an invar suspension spring, which the author found by experience and calculated. Sampson sought to find the deviation by observations on a Shortt clock without allowing for impulse deviation. It is pointed out that the deviation for the master pendulum when it is impulsed is less than the deviation for the pendulum when it is free. In addition to the vibration used for time-keeping, a spring-suspended pendulum has a parasitic mode of vibration which the concentrated Shortt impulse is well adapted to set up. Sampson has analysed the author's previous experiment by the method of least squares and concludes that the solution given is but one of a number of possible solutions. Neither of Sampson's alternatives is a least-squares solution and both involve impossible values of the decrement. The corrected normal equations confirm the original solution. AUTHOR.

3527. Modernised Version of Gibbs' Use of the Grand Canonical Ensemble. R. H. Fowler. *Cambridge Phil. Soc., Proc.* 34. pp. 382-391, July, 1938.—The method of the grand canonical ensemble, as developed by Gibbs, is outlined and a number of formulæ that are important for its use are derived. Its use is illustrated by applying it to a classical gas and to a crystal.

R. P.

See also Abstract 3544.

MECHANICS, QUANTUM.

3528. Eulerian Parameters and Lorentz Transformations. H. S. S. Rao. *Indian Acad. Sci., Proc.* 7A. pp. 339-342, May, 1938.—The Cayley-Klein parameters, as used in the theory of top motion, were recently extended [see Abstract 5223 (1937)] to the problem of four-dimensional rotations. In this paper is considered a similar procedure for the Eulerian parameters (another of the quantities used in the theory of top motion), and it is shown that in this case the generalisation to four dimensions is more natural, and that similar relationships to the spinor calculus arising from Dirac's relativistic theory of the electron also exist.

N. M. B.

3529. Dirac's Equations in Riemannian Metric Space. W. Benedictus. *Comptes Rendus*, 206. pp. 1951-1953, June 27, 1938.—This mathematical treatment, developing an expression for the equations, introduces the invariant derivative for spinors without using the notion of parallel displacement or assuming the existence of orthogonal congruences.

N. M. B.

3530. Interpretation of Quantum Theory. A. Landé. *Frank. Inst., J.* 226. pp. 83-98, July, 1938.—The view is expressed that the relation of the notions of waves and particles, as used by quantum theory, are more complicated than they are taken to be in the commonly accepted interpretation of quantum mechanics, and in particular that the wave intensity does not measure directly the probability of finding a particle in a particular position. R. P.

3531. Determination of Eigenvalues. P. Urban. *Ann. d. Physik*, 32. 5. pp. 471-488, July, 1938.—A mathematical method for determining the eigenvalues of Schrödinger's equation in certain cases is developed, which is completely equivalent with Schrödinger's perturbation method. The method is applied to the problem of the spherical pendulum and a power series for its eigenvalues is obtained. R. P.

3532. Theory of the Neutral Particle. W. H. Furry. *Phys. Rev.* 54. pp. 56-67, July 1, 1938.—A method due to Majorana of eliminating the states of negative energy in Dirac's wave equation is elaborated and formulated without special reference to a particular set of Dirac matrices. The method cannot be generalised to account for the effect of external electric or magnetic fields, but it can be made to work for a non-electric scalar field. Although the negative states are avoided from the beginning, the theory meets with the same difficulties and singularities as the usual theory of positive and negative electrons. R. P.

3533. Energies Associated with the Two-Centre Problem. Part I. General Features of the Energy Surface. E. Monroe. *Cambridge Phil. Soc., Proc.* 34. pp. 375-381, July, 1938.—A scheme is presented to show the limiting behaviour of the electronic energy levels in the diatomic one-electron problem for unequal centres, as the ions are separated. This generalises the well known order of levels in the hydrogen molecule ion. Certain implications of the result for the properties of asymmetric diatomic molecules are briefly discussed. AUTHOR.

3534. Completely Relativistic Wave Mechanics. L. Chadenson. *Comptes Rendus*, 207. pp. 213-215, July 18, 1938.—The author points out that his modification of the Dirac quantum theory [see Abstract 3488 (1936)] has the advantage of disposing of the states of negative energy. G. C. McV.

See also Abstracts 3437, 3583, 3779, 3816, 3832.

PHILOSOPHY OF SCIENTIFIC METHOD.

3535. Application of Statistical Methods to Manufacturing Problems. W. A. Shewhart. *Frank. Inst., J.* 226. pp. 163-186, Aug., 1938.—The application of statistical methods in mass production makes possible the most efficient use of raw materials and manufacturing processes, effects economies in production, and makes possible the highest economic standards of quality for the manufactured goods used by all of us. The story of the application, however, is of much broader interest. The economic control of quality of manufactured goods is perhaps the simplest type of scientific control. Recent studies in this field throw light on such broad questions as : How far can Man go in controlling his physical environment? How does this depend upon the human factor of intelligence and how upon the element of chance? AUTHOR.

See also Abstract 3522.

PRESSURE.

*3536. Measurement of Pressures upon a Body Rotating in the Air. E. Brun. *Comptes Rendus*, 206. pp. 1876-1877, June 20, 1938.—The difficulty of securing an air-tight joint between the tube transmitting the pressure from the point of the body at which the pressure is to be measured and the manometer is overcome by taking readings of pressure on a manometer rotating with the body. A device for doing this is briefly explained. J. S. G. T.

*3537. Precision Oil Manometer. T. C. Chadwick and S. Palkin. *Indust. and Engin. Chem. (Analytical Edition)*, 10. pp. 399-400, July 15, 1938.—The manometer is a simplified form of the double U-tube type manometer previously described. It is, in effect, a single U-tube type, and requires no backing liquid such as was used in the more complicated form. A detailed drawing of the construction is given, and the method of preparation for use is fully described. S. W.

*3538. Vacuum Seal. W. E. Bahls. *Trans. A.I.E.E.* 57. pp. 373-378, July, 1938.—A new type of lead-in structure for vacuum-, gas-, or oil-tight chambers is described in which porcelain bushings are sealed to metal by means of a glass which serves as a bonding agency. The method of assembly is extremely simple, requiring no skilled workmen or elaborate equipment. Some of the features and some of the places where the seal is being applied are discussed. AUTHOR.

*3539. Vacuum Relay. C. W. Miller. *Journ. Sci. Instruments*, 15. pp. 263-265, Aug., 1938.—An arrangement is described whereby a Pirani gauge may be used in an a.c. control circuit to open or close an external circuit when the pressure in a vacuum system exceeds any given value. The performance of such a device is given. AUTHOR.

See also Abstract 3770.

RELATIVITY AND ETHER.

3540. Reduction of Einstein's Gravitational Equations to the Normal Form. A. Finzi. *Accad. Lincei, Atti*, 27. pp. 324-330, April 3, 1938.—It is shown that Einstein's gravitational equations can be reduced to the normal form if instead of the usual coordinates isometric coordinates are introduced. L. K.

3541. Experimental Study of the Rate of a Moving Atomic Clock. H. E. Ives and G. R. Stilwell. *J.O.S.A.* 28. pp. 215-226, July, 1938.—The displacement of the centre of gravity of the Doppler lines in and against the motion of the H particles in a canal-ray beam with respect to the undisplaced lines is given by $\lambda = \lambda_0 (1 - V^2/c^2)^{1/2}$ where V is the velocity of the particles [see Abstracts 4864 (1937)] and 481 (1938)]. A tube similar to Dempster's and a grating of dispersion 10 Å/mm. were used. The observed shifts are compared with the values calculated from the measured voltages and from the observed total Doppler displacement. The agreement is good and gives positive evidence for the Larmor-Lorentz theory. The weakness of the work lies in the fact that the separation of the components of H, the line used, is greater than the observed shift (0.01 to 0.047 Å). H. G. C.

See also Abstract 3580.

SOLUTION.

See Abstract 3757.

SURFACE PROPERTIES.

3542. Sorption of Vapours by Cellulose and Derivatives. K. Kanamaru and J. Chao. *Kolloid Zeits.* 84. pp. 85-99, July, 1938.—The sorption isotherms of various cellulose preparations and their derivatives for vapours of various organic liquids have been determined. The isotherms are considered in relation to the form of the preparation (powdered granular, thread, etc.) and the physical properties, especially dielectric constant of the liquids and adsorbents. In comparison with other forms films of cellulose and cellulose derivatives have a smaller capacity for sorption of vapours of relatively low vapour pressure, and a higher capacity for those with higher vapour pressures. A. J. M.

3543. Activation of Charcoal by ZnCl_2 . G. G. Kandilarow. *Kolloid-Beihefte*, 48. 1-3. pp. 1-32, 1938.—A review of the processes involved in the activation of charcoal is given, and experiments on the preparation of activated charcoal by the carbonisation of cellulose treated with ZnCl_2 are described. ZnCl_2 increases the activity of the charcoal by removing impurities and thus increasing the area of active surface, and by facilitating the formation of a disordered arrangement of C atoms. The best method of preparing activated charcoal using ZnCl_2 embodying these results is described. A. J. M.

3544. Theory of Cooperative Phenomena. G. S. Rushbrooke. *Cambridge Phil. Soc., Proc.* 34. pp. 424-428, July, 1938.—The statistical theory of adsorption is worked out on the assumption that the heat of adsorption varies linearly with the fraction of surface already covered, and that the adsorbed molecules can perform vibrations with a frequency that again varies linearly with the covered surface. In general the change in the adsorption isotherms is only quantitative, but if the dependence of the vibration frequency on the adsorbed amount is very large it is possible to obtain critical conditions above a certain critical temperature, rather than below a certain temperature as in the usual conditions. R. P.

3545. Statistical Theory of Adsorption. Part I. F. Cernuschi. *Cambridge Phil. Soc., Proc.* 34. pp. 392-398, July, 1938.—The adsorption of atoms in two layers is studied for the following two simplified models: (1) The interaction between the atoms in each layer is neglected, but it is assumed that a second-layer atom can be attached wherever four neighbouring first-layer atoms form a square; (2) the effect of the interaction within each layer is taken into account in a crude way. Both these calculations lead to the possibility of critical phenomena. R. P.

3546. Properties of Mobile and Immobile Adsorbed Films. J. K. Roberts. *Cambridge Phil. Soc., Proc.* 34. pp. 399-411, July, 1938.—The essential difference between mobile and immobile adsorbed films of gases on solids when there is repulsive interaction between adsorbed particles is discussed. Ordinary statistical methods can be applied to the equilibrium configurations of the particles in a mobile film but not to immobile films. Films formed by the adsorption of diatomic molecules with dissociation are then considered. It is pointed out that for a mobile (equilibrium) film there are differences between the true heat of adsorption and the apparent heat obtained from the temperature variation of the evaporation rate. A detailed comparison is made by obtaining a formula for the apparent heat of evaporation and comparing it with that for the true heat obtained earlier by Wang [see Abstract 2868 (1937)] and the physical reasons for the differences are discussed. A model suitable for

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studying the pseudo-equilibrium states in immobile films is described and formulæ and diagrams in connection with the kinetics of the formation of such films and the variation of heat of adsorption with fraction of surface covered are given. [See following Abstract.] AUTHOR.

3547. Kinetics of Adsorption with Long-Range Interaction between Adsorbed Particles. J. S. Wang. *Cambridge Phil. Soc., Proc.* 34. pp. 412-423, July, 1938.—The rates of condensation and evaporation of adsorbed particles when they interact with long-range forces are deduced from kinetic considerations, including also the case of adsorption of diatomic molecules with dissociation. The rate of evaporation is compared with experiment, and the variation of the dipole moment with θ required to make the theory agree with experiment is discussed. Finally the formulæ for the rates of condensation and evaporation are applied to the problem of the diffusion of gases through metals, and it is found that for the processes considered the effect of interaction does not alter the conclusion arrived at in an earlier paper [see Abstract 46 (1937)] concerning the diffusion equation at small p and at large p . [See preceding Abstract.] AUTHOR.

3548. Adsorption. P. Harteck. *Zeits. f. Elektrochem.* 44. pp. 468-473, Aug., 1938.—This subject is reviewed under the headings: (1) Van der Waals' adsorption and adsorption produced by polar forces (which lead in the vicinity of the saturation pressure of the adsorbent to capillary condensation. (2) Activated Adsorption: (a) Reversible, (b) Irreversible (Chemisorption). The dependence of adsorption processes on temperature and pressure, the velocity with which the adsorption equilibrium is regulated, and the processes of separating individual gases from mixtures almost quantitatively, are dealt with for various adsorbents: For theoretical study, smooth surfaces are the best to investigate. Adsorption proceeds in general without heat of activation and the amounts of gas adsorbed rise with falling temperature. Recently, however, cases of adsorption have been found which do not decline with rising temperature but indicate an activated adsorption. Experiments with para H_2 and D_2 have permitted further insight into the nature of adsorption. Adsorption processes at high temperatures should throw light upon the mechanism of catalysis. The paper is illustrated by 5 diagrams. H. H. Ho.

3549. Differential Method for the Measurement of Small Amounts of Adsorbed Gases. W. Hunsmann. *Zeits. f. Elektrochem.* 44. pp. 540-542, Aug., 1938.—A differential volumetric process has been devised, and a suitable apparatus designed, in order to construct isotherms at higher temperatures for the measurement of the duration of adsorption according to the method of Langmuir. Full details with diagrams are included for measurements of the superficial adsorption of ethane at oxidised Ni foil. H. H. Ho.

3550. Heats of Adsorption of Alkalis by Standard Cellulose. J. L. Morrison, W. B. Campbell and O. Maass. *Canad. J. of Research*, 16. Sect. B. pp. 195-202, June, 1938.—The heats of adsorption of aqueous NaOH, KOH and LiOH and some salt solutions by cotton cellulose have been measured. The adsorption of alkali by cellulose seems to be ionic rather than molecular; more particularly, it appears to be closely related to the availability of the H^+ ion from the very weakly acid cellulose, and of the OH^- ion from the electrolyte. AUTHORS.

3551. New Method of Measuring Surface Tension of Liquids. V. Naggiar. *Comptes Rendus*, 206. pp. 1882-1884, June 20, 1938.—A drop of liquid is suspended in a small circular hole cut in a thin metal plate. Measurements of the radii of curvature of the surfaces of the drop, together with its thickness, determine the surface tension. Only a few mg. of liquid are required and it is unnecessary to know the angle of contact. An accuracy of ca. 1% is claimed. G. C. E.

3552. Fine Structure of Boundary Surfaces. T. Schoon. *Zeits. f. Elektrochem.* 44. pp. 498-507, Aug., 1938.—This subject is discussed under the following headings: (a) Theoretical Study of the Atomic Arrangements in the Solid Surfaces of Crystals. (b) Theories with respect to Atomic Distances and Electric Fields in Boundary Surfaces. (c) Experimental Methods. Of the methods examined, that of electron diffraction has proved to be the most fruitful, and its limitations and difficulties are discussed. (d) Expansion or Contraction of the Lattice Distances. Experiments are described which indicate that for crystals with ionic unions the lattice surfaces contract, whereas for crystals with covalent bonds expansion occurs in accordance with theoretical requirements. (e) Degrees of Surface Roughness. (f) Material Composition of the Surface Layer. (g) Surface Fields of Force. The changes in chemical properties which accompany group or atom changes in the surface are discussed for the fatty acids and their salts, and also for zinc blende. The electron diffraction data for MgO, Al₂O₃ and graphite are also briefly considered. The paper includes 16 diagrams. H. H. Ho.

3553. Relationships between Parachor Values and the Physical Constants of Homologous Series. D. T. Lewis. *Chem. Soc., J.* pp. 1056-1061, July, 1938.—Relationships are put forward connecting the parachor values with the critical temperatures and boiling points of substances in homologous series. The silico-paraffins obey a relation having the same numerical constants as the corresponding hydrocarbons. Associated substances such as the alcohols and acids do not obey these relations. By utilising these generalisations certain doubtful atomic parachors have been calculated, and various physical constants predicted. The connection between these relations and the co-volume factor of the van der Waals equation is discussed, the parachor being regarded as a true comparative measure of molecular volume. AUTHOR.

3554. Large-Scale Representation of Monomolecular Films. H. Devaux and L. Pallu. *Comptes Rendus*, 206. pp. 1693-1695, June 8, 1938.—Most of the properties of monomolecular films can be reproduced on a macroscopic scale by means of discrete particles floating on a Hg surface. P. H. B.

3555. Monomolecular Layers. R. Brill. *Zeits. f. Elektrochem.* 44. pp. 459-468, Aug., 1938.—This very comprehensive paper, which is illustrated by 9 diagrams, deals with the subject under 4 headings, viz., (1) The preparation of monomolecular layers. (2) Measurement of the spreading-pressure and the states of aggregation thereby found for such layers. (3) The influence of ions at great dilution. (4) Preparation of synthetic films and their principal properties. H. H. Ho.

3556. Mechanical Properties of Films and Stability of Foams. P. A. Reh binder and A. A. Trapeznikov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 7. pp. 423-426, 1938. In English.—Attempts to measure the surface viscosity of sodium oleate solution by means of a horizontal oscillating disc [see Abstract 1493 (1938)] failed to

show any such viscosity. That of such solutions of concentration $c = 1.05-0.03\%$, was, however, measured (I) within 2 days of preparation, and (II) after 50 days ageing, by determining the logarithmic decrement (λ) of the oscillation of a ring (5.39 cm. dia.) of Pt wire (1 mm. thick) oscillating within a fixed similar concentric ring 6.12 cm. dia., both being horizontal in the surface of the solution. λ is plotted against c . In both curves λ shows a maximum for $\lambda = 0.045$, but the whole curve for (II) lies well below that for (I). The stability of the foam formed by such solutions was also determined after intervals of 30 sec. to 22 hr. from time of preparation, and plotted against c . The stability decreases with lapse of time, and after 22 hr. shows a distinct maximum for $c = 0.04\%$ approximately. [See following Abstract.] C. A. S.

3557. Stabilising Effect of Adsorption Layers and Their Mechanical Properties. A. A. Trapeznikov and P. A. Rehbinder. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 7. pp. 427-430, 1938. *In English*.—The stabilising action of adsorption layers as functions of their surface concentrations was investigated by determining the life of bubbles at the surface of water (or 0.01-N-HCl) covered with films of an insoluble acid (lauric, myristic, palmitic and oleic were used), alcohol or ester. Results are shown by curves, and generally indicate a maximum effect for a smaller area per molecule than that obtained by previous investigators. [See Abstract 1395 (1931) and preceding Abstract.]

C. A. S.

3558. Mercury-Solution Boundary Layers of Organic Substances. A. Gorodezkaya and A. Frumkin. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 9. pp. 639-643, 1938. *In English*.—The examination of thin layers on the surface of Hg in solutions of electrolytes affords the possibility of studying the influence of the electric field upon the properties of the layer. Moreover, at this boundary it is possible to obtain thin polylayers, since a drop of organic acid spreads completely over the surface of the Hg electrode polarised to the potential corresponding to the maximum of the electrocapillary curve. A new method is now described for the study of thin layers at this boundary, based on the fact that the capacity of the double electrical layer of a metallic electrode, in the case of the penetration of organic molecules into that double layer, ought to be considerably reduced. The method of capacity measurements used does not differ essentially from that of Borissowa and Proskurnin [see Abstract 4348 (1936)]. The paper deals with measurements of electrode capacity with constant surface, films of cetyl alcohol and palmitic and oleic acid being employed, and also when the Hg surface is compressed.

H. H. Ho.

3559. Investigation of Surface Phenomena by Radioactive Methods. O. Hahn. *Zeits. f. Elektrochem.* 44. pp. 497-498, Aug., 1938. —A brief review of radioactive methods and of substances employed is given, and it is pointed out that radio-active gaseous substances (e.g., thoron) are most suitable for the study of inner boundary surfaces and their changes (by the emanation method). Recent investigations on the thermal behaviour of iron oxide hydrogel have indicated that relaxation phenomena can occur according to the mode of water release, which depend on the mode of preparation of the gel, and which can be voluntarily produced or avoided. It has been shown that a spontaneous decline of active boundary surface need not be accompanied by a corresponding increase of primary particles (formation of secondary particles without

noticeable recrystallisation). The emanation method used for crystallised salts has established the occurrence of thermal relaxation and recrystallisation of alkaline earth carbonates as dependent on grain size and degree of purity.

H. H. Ho.

See also Abstracts 3452, 3467, 3468, 3517, 3566, 3760, 3787, 3829, 3830, and 2576 & 2577B. Lubrication. M. Muskat and F. Morgan.

TIME.

***3560. New Schuler Clock.** H. Gockel and M. Schuler. *Zeits. f. Physik*, 109. 7-8. pp. 433-458, 1938.—The clock is fitted with a self impulsing system in place of the auxiliary clock used in earlier models. It is claimed that temperature, amplitude and impulsing errors are so small that changes of rate are less than a few thousandths of 1 sec. a day. The pendulum is not more sensitive to shock than any other ordinary pendulum. The knife-edge suspension has proved itself satisfactory according to measurements extending over three years. On comparing the new Schuler clock with one of the earlier type, it was found that changes in the differential rate, of the order of 0.01 sec./day, occurred every few days. These changes appear to coincide with similar changes in the Shortt clock which serves as the source of the Rugby time signals, so earth tremors are probably responsible, though in what manner, it is difficult to say. P. H. B.

***3561. Quartz Clock.** L. Essen. *Roy. Astron. Soc., Occasional Notes*, No. 1. pp. 7-12, June, 1938.—A brief explanation is given of the principles involved in the construction of a quartz clock. The performance of the clock, as compared with the pendulum clock, is discussed. The paper concludes with a short account of the quartz clock at the National Physical Laboratory. [See Abstract 2189 (1938).] L. E.

***3562. Centrifugal Carry-Over Device for Synchronous Clocks.** H. Bock. *Zeits. f. Instrumentenk.* 58. pp. 261-264, July, 1938.—A theoretical investigation of the dynamics of the centrifugal arrangement described by Jarry in *Annales françaises de Chronometrie*, 1937, Nr. 3, by means of which short current-less intervals in the feed of synchronous clocks can be bridged over. The arrangement is found to be very satisfactory theoretically, and worthy of more widespread use.

P. H. B.

See also Abstracts 3525, 3526, 3573, 3579.

VISCOSITY AND FRICTION.

3563. Rates of Displacement in Viscous Bodies under Applied Stress. R. W. Douglas. *Soc. Glass. Technol., J.* 22. pp. 206-213, June, 1938.—The analogy which exists between the slow steady motion of a viscous body and elastic displacements has been used to derive the equations for the rates of distortion of heated glass cylinders under pressure. The calculations have been verified experimentally. AUTHOR.

3564. Dependence of Viscosity of Fluids on Molecular Volume, and Application of Principle of Continuity of State. D. T. Lewis. *Chem. Soc., J.* pp. 1061-1066, July, 1938.—The viscosities of gases are shown to depend on the molecular weight and the molecular cross-sectional area, as predicted mathematically by Chapman. The derived parachor equation is shown to account satisfactorily for the behaviour of fluids in general, and is applied to many liquids, a generalisation emphasising the importance of the principle of the continuity of state. Andrade's equation for the variation of the viscosity of a simple substance with temperature

is shown to follow directly from the general equation, and the connection between the constants of this equation and the molecular weight and volume is demonstrated.

AUTHOR.

3565. Viscosity of Air, Oxygen and Nitrogen. P. J. Rigden. *Phil. Mag.* 25. pp. 961-981, June, 1938. *Supplement*.—The paper describes improvements to Bond's apparatus for the measurement of viscosity [see Abstract 2448 (1937)] and the results obtained. The important improvements were the use of Apiezon "A" in place of light paraffin in the U-tube and the enclosure of the apparatus to protect it from local temperature fluctuations. Details are given of the checks made on the various correction factors and of the complete experimental procedure. The final value for the viscosity of air at 23° C. is $(1830.34 \pm 0.6) \times 10^{-7}$ c.g.s. and this value substituted in Millikan's data on e gives a value 4.800×10^{-10} e.s.u. which is in good agreement with that recently deduced by v. Friesen [see Abstract 2892 (1937)]. The values obtained for O₂ and N₂ and the temperature coefficients are O₂, $(2010.5 \pm 0.9) \times 10^{-7}$ c.g.s. Temp. coefficient 6.23×10^{-7} ; N₂, $(1738.2 \pm 0.7) \times 10^{-7}$ c.g.s. Temp. coefficient 4.76×10^{-7} .

F. S. B.

***3566. Influence of Surface Tension on Viscosity Measurement. Viscosity of Methanol.** G. Jones and H. J. Fornwalt. *Am. Chem. Soc., J.* 60. pp. 1683-1692, July, 1938.—It is demonstrated by mathematical analysis and by experiments on methanol and water that surface tension effects may influence the measurement of viscosity with the Ostwald viscometer. A method of computing the error due to surface tension for an instrument of known dimensions is given. The viscosity of methanol at 25° relative to that of water is 0.6084. The principles of design of the Ostwald viscometer to give high precision without unnecessary sacrifice of convenience and speed in operation are discussed.

AUTHORS.

3567. Viscosity of Liquid and Gaseous Propane. B. H. Sage and W. N. Lacey. *Indust. and Engin. Chem.* 30. pp. 829-834, July, 1938.—The effect of pressure upon the viscosity of liquid and gaseous propane has been determined at five temperatures between 100° and 220° F. The work includes measurements throughout the superheated gas region and the condensed liquid region at pressures up to 2000 lb./in².

AUTHORS.

***3568. Viscosity of Liquid Helium.** W. H. Keesom and G. E. Macwood. *K. Onnes Lab., Leiden, Comm. No. 254a. Physica*, 5. pp. 737-744, Aug., 1938. *In English*.—An apparatus for the measurement of the viscosity of liquids and gases, interchangeably, is described. Measurements of the viscosity of liquid He made with this apparatus are reported. The measurements were made over the temperature range from 1.2 to 4.0° K.

AUTHORS.

3569. Viscosity of Hydrogen Vapour. W. H. Keesom and G. E. Macwood. *K. Onnes Lab., Leiden, Comm. No. 254c. Physica*, 5. pp. 749-752, Aug., 1938. *In English*.—Measurements of the viscosity of the saturated vapour of liquid H₂ from 14.5 to 20.3° K. are reported.

AUTHORS.

3570. Theory of Oscillating Disc Method of Measuring Viscosity and Slip of Fluids. Part II. G. E. Macwood. *K. Onnes Lab., Leiden, Comm. No. 84c. Physica*, 5. pp. 763-768, Aug., 1938. *In English*.—A calculation is given of the correction to be applied to the viscosity as determined by oscillating disc apparatus which allows for the inertia and viscosity of the exterior fluid previously neglected. It is found that for large disc separations the correction may be large, while

for small separations it is usually negligible. [See Abstract 2316 (1938) and following Abstract.] AUTHOR.

3571. Viscosity of Liquid Hydrogen. W. H. Keesom and G. E. Macwood. *K. Onnes Lab., Leiden, Comm. No. 254b. Physica*, 5. pp. 745-748, Aug., 1938. *In English*.—An experimental verification is given of the corrections (see preceding Abstract) for viscosities determined by the oscillating disc method. The viscosity of liquid H_2 in the temperature range from 14.8° to 20.0° K. is reported. AUTHORS.

See also Abstract 3443.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***3572. Tolerances Permissible in Flats for Autocollimation Tests.** C. R. Burch. *Roy. Astron. Soc., M.N.* 98. pp. 670-672, June, 1938.—Limits are obtained for the tolerance of spherical convexity or concavity permissible in a flat used for autocollimation. Only the focal ratio of the system and its offence against the sine condition are involved; the determination of the "coefficient of offence" by knife-edge measurements is described. AUTHOR.

***3573. Induction Brake Control for an Astronomical Drive.** C. S. Venkateswaran. *Journ. Sci. Instruments*, 15. pp. 265-267, Aug., 1938.—A fine control for astronomical driving clocks, based upon the principle of electromagnetic induction, is described. AUTHOR.

COMETS AND METEORS.

3574. Structure of the Violet Bands of Cyanogen in Cometary Spectra. J. Dufay. *Comptes Rendus*, 206. pp. 1948-1951, June 27, 1938.—It is shown that the phenomena occurring in the CN spectra of the comets can be explained by the hypothesis that the energy of rotation increases with decreasing distance from the sun. The spectra of five comets taken since 1936 are used to demonstrate this relation. The interval $\Delta\lambda$ between the two principal maxima of intensity (P and R branch) is about twice as great in the spectrum of the comet Wilck as in the spectrum of the comet Whipple while their solar distances have the ratio $0.75/1.80$. L. K.

3575. Physics of Meteoric Phenomena. M. A. R. Khan. *Current Science*, 12. pp. 635-636, June, 1938.—A brief account of the observed phenomena of meteors, with special reference to the trails left behind them, followed by a brief account of the theories suggested to account for them. C. A. S.

COSMOGONY.

3576. Origin of Satellites. R. A. Lyttleton. *Roy. Astron. Soc., M.N.* 98. pp. 633-645, June, 1938.—The masses of the primitive planets must have been comparable with those of the great planets, the terrestrial planets being far too small to have condensed from stellar material. The search for the origin of satellites leads to the consideration of a single

planet, extraneous agencies having been shown to be unsuitable for generating satellites. Rotational instability must be involved to produce any disruption of a single mass, but this process produces two bodies of comparable though necessarily different mass. If Jupiter and Saturn are regarded as the masses resulting from such a catastrophic disruption of a single primitive planet, it must be assumed that the avulsion endowed Saturn with sufficient velocity to escape from Jupiter. A filament of material would stream out between the departing components, and the end portions adjacent to the planet would be captured and possibly give rise to satellites. The intervening portions of the filament would go to neither planet and accordingly themselves become independent planets; the terrestrial planets must be relegated to some such origin as this, if their difference of composition is to be explained, and the existence of the Moon may also find an explanation in this same disruption. **AUTHOR.**

3577. Origin of Binary Stars. R. A. Lyttleton. *Roy. Astron. Soc., M.N.* 98. pp. 646-650, *June, 1938.*—The pear-shaped series of configurations of a rotating mass of liquid is not only secularly unstable, but also ordinarily unstable, and this indicates that the fission of a body takes the form of the radial ejection of a portion of the mass. Considerations of the subsequent motion of the two components leads to the view that they must be endowed with sufficient energy to escape from each other, otherwise a collision would occur and cause them temporarily to reunite. If this interpretation of fission is correct the origin of binary stars by fission must be forfeited, and any deductions from it relating to the time-scale. **AUTHOR.**

3578. Evolution of Eclipsing Binaries. Z. Kopal. *Roy. Astron. Soc., M.N.* 98. pp. 651-657, *June, 1938.*—The main subject of the present paper is to investigate from the point of view of the fission theory whether the empirical relation between the radii-ratio and the separation of components in eclipsing binary systems, shown in the diagram and fulfilled remarkably well by nearly two hundred eclipsing systems, can be interpreted as an evolution from close to wide pairs. It is found that the general features agree exactly with the expectations of the fission theory; but in order that the observed increase of dimensions may be possible, the eclipsing systems must have far larger stores of angular momenta in the rotation of their components than the amount calculated from the assumption that they rotate with constant Keplerian angular velocities throughout. A rapid increase of the angular velocity inwards would account for this, and is therefore strongly suggested; but so long as we have no definite idea about the structure of stellar configurations, the observational results do not lend themselves to quantitative conclusions. **AUTHOR.**

3579. Empirical Cosmology. P. Jordan. *Naturwiss.* 26. pp. 417-421, *July 1, 1938.*—In continuation of his work [see Abstract 3906 (1937)] on the relation of the fundamental physical constants to cosmology, the author gives an account of the elementary processes involved in the measurement of length and of time in Euclidean and Riemannian geometry. The significance of the Hubble effect in relation to the stability of the universe is discussed, as is also the fundamental relation which states that the ratio of the mass of the universe to that of the proton is equal to the square of the radius of the universe expressed in elementary units e^2/mc^2 . This latter leads to a discussion of the ages of the spiral nebulae, and it is deduced that the constant of gravitation should decrease in inverse proportion to the age of the universe. The various cosmological

time-scales which have been proposed are analysed from the physical point of view, and the reactions on cosmological theory both of recent astronomical discoveries and of the new concepts of physics are considered in general terms. A. Hu.

3580. Electrodynamics and Cosmology. H. Mandel. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 8. pp. 543-547, 1938. *In German.*—The generalised non-linear electrodynamics proposed by Born in classical (i.e. non-quantised) form is given a geometrical basis in terms of 5-dimensional unified field-theory. A study of Born's tensor F_{ik} leads to a knowledge of the cosmological properties of 5-dimensional space, with especial reference to its curvature on certain assumptions. A. Hu.

3581. Spatial Distribution of Spiral Nebulæ in Milne's Universe. W. Fricke. *Zeits. f. Astrophysik*, 16. 1-2. pp. 11-20, 1938.—The author shows that the figures given by Hubble for the nebulæ, are compatible with a plane expanding universe provided the relation between the brightness of the nebulæ and the red shift is taken to be $\Delta \simeq 2.9 \frac{d\lambda}{\lambda}$. This means that the effective temperature of the nebulæ is 7500°K. , and the age of the universe 1.82×10^9 years. The density distribution of the nebulæ is calculated on Milne's gravitational theory. The mean mass of a nebula is also calculated under these assumptions, but the resulting value $m_0 = 1.50 \times 10^{12} \odot$ is much higher than can be expected. A modification of the gravitational theory is suggested. [See following Abstract.] L. K.

3582. Kinematical Theory, Curved Space and the Distribution of Nebulæ. G. C. McVittie. *Zeits. f. Astrophysik*, 16. 1-2. pp. 21-28, 1938. *In English.*—Fricke's contention [see preceding Abstract] that Hubble's nebular counts can be satisfactorily interpreted in terms of Milne's kinematical theory in flat space is shown to depend on an inexact use of the theoretical relation between red-shift δ and apparent photographic magnitude m . If the δ, m formula is used correct to the second order in δ , a direct appeal to Hubble's five counts and to the two Harvard counts shows that a close fit for the observations is obtained only by the use of curved space. The corrections to m due to red-shift are investigated and it is also shown that the average density of matter in the inner metagalactic system is of the order of $10^{-29} \text{ gm./cm.}^3$ [See also Abstract 510 (1938).] AUTHOR.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

3583. Wave Theory in Celestial Mechanics. P. Chadenson. *Comptes Rendus*, 207. pp. 119-121, July 11, 1938.—A relativity theory is advanced in which the fundamental element ds^2 possesses by definition all the spatial and gravitational properties of the Einstein ds^2 . Instead of assuming a 4-dimensional space and working out its consequences, a simplified law of gravitation is taken and the corresponding Riemannian space sought. The law chosen is analogous to the electromagnetic laws in that it is derived from Newton's law as the latter are from Coulomb's law. This law is assumed to hold on the atomic scale, and thence a quantum constant not of action but of dimensions L^2T^{-1} is derived. The quantum conditions and in particular the orbital dimensions not

involving the mass of the planetary electron, the Schrödinger-Dirac transformation is applied in the case of the solar system. By appropriate choice of quantum number, fairly accurate values for the radii of the planetary orbits are obtained. The theory is also successful with the satellites of the major planets. A. Hu.

3584. Restricted Three-Body Problem. N. Rein. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 1-2. pp. 37-40, 1938. *In French.*—Formulæ are developed from which the period in a closed trajectory obeying the conditions of the problem can be evaluated whether the case is one of direct or of retrograde synodic motion. Where the trajectory is not exactly known, but the interior and exterior lines of an annulus containing it can be defined, a method is given for finding upper and lower limits to the period. The development of the subject is traced from the general case of a body moving in the gravitational field of two finite masses in relative motion, through the particular case to which the Jacobi integral relates, to the restricted circular problem and thence to the more general case of motion in Kepler ellipses. The difficulty, in the elliptical problem, of our ignorance of a first integral analogous to Jacobi's is overcome by introducing a modified scheme for which such an integral exists. The simplified scheme of Fatou, employing Gaussian annular rings, is not altogether satisfactory. The author suggests one in which the attraction of the central masses is replaced by that of material rings whose dimensions are proportional to the eccentricity of the elliptical orbits, and along which the attracting matter is distributed proportionally to the time spent in each element of the orbit. A. Hu.

NEBULÆ.

3585. Photographic Photometry of the Elliptical Nebulæ. (Second Paper). R. O. Redman and E. G. Shirley. *Roy. Astron. Soc., M.N.* 98. pp. 613-623, June, 1938.—In continuation of work already published [see Abstract 3071 (1936)], the distribution of surface brightness has been measured along the principal axes of nine elliptical nebulæ. The amount of instrumental and other distortion has been determined by measuring focal star images, and it is shown that the errors in the surface brightness should be well under 0.1 in log I, except at distances less than 0.1 from the centre of the nebula. The surface luminosities have been integrated on the assumption of elliptical isophotal contours, an approximation which has been checked and found sufficiently accurate. Integrated luminosities were reduced to stellar magnitudes by comparison with extra-focal images of standard stars. The results are on the average 0^m.6 brighter than the values of the Shapley-Ames catalogue. It is noted that the axis ratio of the isophotal contours does not in general remain perfectly constant throughout each nebula, while the visual estimates of Heidelberg and Harvard catalogues appear to give ellipticities systematically too great, a fact of importance in connection with the supposed excess of elongated nebulæ in the sky. AUTHORS.

See also Abstracts 3581, 3582.

PLANETS.

3586. Minor Planet Hermes. H. Spencer Jones. *Roy. Astron. Soc., Occasional Notes, No. 1.* pp. 3-6, June, 1938.—Images of the asteroid

(1937 UB: Hermes), discovered on Oct. 28 by Reinmuth, were also found on plates of Oct. 25, 26, 27, 28, 29, but not found on Oct. 30, when at its nearest to the earth, for it then moved through 6 hr. of R.A. in the course of 24 hr., its apparent magnitude being then (probably) 6.6. Cunningham gives its nearest approach to the earth as on Oct. 30.5, and as 485,000 miles; the least distance between their orbits being 22,000 miles and the inclination of the two orbits, 6° ; its period is 2.1217 yr. and eccentricity is (doubtfully), 0.626. The diameter of Hermes is less than a mile. A diagram is given of the orbit in relation to those of the four inner major planets.

A. S. D. M.

See also Abstract 3576.

STARS.

3587. Distribution of Absolute Magnitudes in the Vicinity of the Sun. W. J. Luyten. *Roy. Astron. Soc., M.N.* 98. pp. 677-680. June, 1938.—The stars with proper motions larger than $0''.5$ annually which were obtained from the Bruce Proper Motion Survey in the Southern Hemisphere have been used to derive the luminosity function. The formula for mean parallax and the dispersion of the true parallaxes around the mean have been obtained from trigonometric parallax material. The resulting luminosity curve shows a maximum around photographic absolute magnitude +15 and appears to possess a steeper descent than rise. The total mass in the vicinity of the sun is estimated at 0.08 sun per cubic parsec.

AUTHOR.

3588. Method of Deriving Constants of Velocity Ellipsoid From Observed Radial Speeds of Stars. W. M. Smart and S. Chandrasekhar. *Roy. Astron. Soc., M.N.* 98. pp. 658-663, June, 1938.—A method is developed, based on Schwarzschild's hypothesis, for the determination of the constants of the velocity ellipsoid (with two equal axes) from the observed radial speeds of the stars.

AUTHORS.

3589. Spectrophotometric Investigations of δ Cephei Stars. Part V. (RT Aurigæ). W. Becker and W. Strohmeier. *Zeits. f. Astrophysik*, 16. 1-2. pp. 1-10, 1938.—From the monochromatic brightness differences between RT Aur. and the comparison star HD 47152 (A0) two gradients are formed the long-wave one of which (635 to 480 $m\mu$) has an amplitude of 0.63 and the short-wave one (480 to 400 $m\mu$) an amplitude of 0.72. Light curves deduced for wave-lengths 557, 478 and 410 $m\mu$ have amplitudes $0^m.74$, $0^m.95$ and $1^m.22$ respectively. The colour indices for 557 and 410 $m\mu$ have amplitudes $0^m.48$ which become $0^m.44$ after reduction to eliminate absorption. The maxima of the short-wave gradient and the observed colour index curve occur $0^d.08$ in advance of that of the light curve. The earliest spectral type (A 8.5) occurs $0^d.15$ after the maximum of the light curve and the latest type (G 0.2) is reached $0^d.15$ before the minimum. The gradient differences for the same spectral type and for the same brightness are determined for both the increasing and the decreasing parts of the curves. [For Part IV see Abstract 1904 (1938).]

J. E. K.

3590. Non-Coherent Formation of Absorption Lines. R. v. d. R. Woolley. *Roy. Astron. Soc., M.N.* 98. pp. 624-632, June, 1938.—A solution of the problem of the non-coherent formation of an absorption line, i.e., formation of an absorption line in the presence of redistribution of frequency, has been attempted by a method of successive approxi-

mation. The main result is the appearance of a strong quasi-collision term in the wings of a weak line. It is suggested that non-coherence is chiefly of importance in centre to limb problems. AUTHOR.

3591. Chemical Composition and Dynamical Stability of Stars.

L. Biermann. *Zeits. f. Astrophysik*, 16. 1-2. pp. 29-42, 1938.—It is shown that the condition for dynamical stability of a star can be put in the form $I/\psi < 3/2(kT/\psi)$, where I is the ionisation energy per free particle and ψ the limiting binding energy at which all electrons are removed by ionisation. The quantity I/ψ is evaluated as a function of ψ for different values of the hydrogen content X , and for several mixtures of the heavier elements. For $X = 0$, I/ψ is approximately 0.2 for $\psi = 500$ to 2000 eV, and is still bigger for $\psi = 60$ to 500 eV. Giants and supergiants, in whose interiors ψ/kT lies between 10 and 15, are therefore dynamically unstable with $X = 0$. With greater H content the value of I/ψ falls; it is 0.07 for $X = \frac{1}{3}$, $\psi = 500$ to 2000 eV. With a constitution of this kind, dynamical stability in such stars is possible. The author points out that the method gives a lower limit to the H content in stars where uncertainty of mass makes the mass-luminosity relation useless.

A. Hu.

3592. Rate of Stellar Radiation. **C. H. Collie.** *Zeits. f. Astrophysik*, 16. 3. pp. 161-166, 1938. *In English*.—It is shown by an appeal to statistical mechanics that neutrons will not be produced in stars by thermal dissociation of heavy elements unless temperatures of 10^9 K. are reached. If neutrons are present then they will cause a large hitherto undetected transport of energy across the stellar boundary by neutrinos. It is shown that this would explain an anomaly in the rate of stellar radiation pointed out by Nernst [see Abstract 1104 (1936)]. AUTHOR.

3593. Relation of Electron Gas Pressure to Radiation Pressure in Degeneracy and Non-Degeneracy. **D. S. Kothari and B. N. Singh.** *Zeits. f. Astrophysik*, 16. 3. p. 200, 1938. *In English*.—Corrections to the original [see Abstract 1910 (1938)].

3594. Compton Scattering of Radiation in a Star. **A. B. Severny.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 1-2. pp. 45-48, 1938. *In English*.—The absorption of radiation due to Compton scattering by free electrons of stellar matter is calculated for the case that a central region of a star radiates photons of the energy $h\nu \gg m_0c^2$. This region is surrounded by matter of the temperature $kT \ll m_0c^2$, and the free-electrons obey the laws of the Fermi statistics. It follows from the calculations that the absorption of radiation due to Compton scattering is small as compared with the photoelectric absorption for temperatures $T < 10^{10}$ K. The two absorptions become comparable if the temperature of the enveloping matter and of the core are $\sim 10^{10}$ K. and higher. The optical depths τ for the Compton absorption will be $\tau = 10^5$ for giants with radii $\sim 10^{12}$ cm., $\tau = 10^9$ for the sun, $\tau = 10^2$ for white dwarfs provided that the non-degenerate layers of the enveloping gas have each a linear depth of about one-tenth of the radius. It follows that penetrating radiation, formed in the centre of a star, passes through the surrounding matter in a negligibly small time out into space. L. K.

3595. Change of Luminosity Function with Height above Galactic Plane. **J. L. Greenstein.** *Astrophys. J.* 87. pp. 577-581, June, 1938.—The stellar density gradient perpendicular to the galactic plane is determined as a function of absolute magnitude from an analysis

of star counts in high latitudes. It is found that giants show much greater concentration toward the galactic plane than dwarfs. AUTHOR.

3596. Theoretical Analysis of Wolff's Method of Star Counts in Dark Regions. K. Ogorodnikoff. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 1-2. pp. 41-44, 1938. In English.—The author examines Wolff's method of determining distance and magnitude of absorption for cases where (1) the stellar counts are made in dark spots and are of equal luminosity; (2) where counts are of the same absolute brightness in dark "clouds" (in obscured regions of large angular extension); (3) where the dispersion of absolute magnitudes is not equal to zero, and here corrections have been derived and formulæ given for both thin and thick nebulae; (4) where dispersion is large and Wolff's method cannot be applied at all. He discusses the three principal anomalies revealed by the curves on the basis of star counts. The generalised theory gives values of absorption and distances different from Wolff's. For area 7 in Cygnus the latter shows a double nebula at distances 170 and 250 parsecs, absorbing 1.7 stellar magnitudes and the former shows a single nebula at 1000 parsecs, absorbing 2.3 magnitudes. A. S. D. M.

3597. Observations of Novæ, 1937-1938. W. H. Steavenson. *Roy. Astron. Soc., M.N.* 98. pp. 673-676, June, 1938.

See also Abstracts 3577, 3578, 3621, 3834.

SUN.

3598. Height of the Chromosphere in 1937. G. Abetti. *Accad. Lincei, Atti*, 27. pp. 317-318, April 3, 1938.—The observations of the height of the solar chromosphere in 1937 are tabulated. There have been no changes since 1936 and the distribution over the solar sphere has remained the same. In the higher layers of the chromosphere the state of perturbations is the same in 1937 as in 1936, while in the lower layers the activity of the sun has considerably increased in 1937. [See Abstract 3957 (1937).] L. K.

3599. Brightness Variations and Structure of Solar Granulation in the Ultra-Violet. P. ten Bruggencate, W. Grotrian and E. v. d. Pahlen. *Zeits. f. Astrophysik*, 16. 1-2. pp. 51-112, 1938.—Simultaneous photographs of granulation in u.v. ($\lambda_{\text{effective}} = 3720 \text{ \AA}$) and infra-red ($\lambda_{\text{effective}} = 7000 \text{ \AA}$) are similar in broad details; the infra-red photographs show a finer resolution of detail. The accuracy of the photometric method used is proved by determination of the edge darkening up to $\cos \theta = 0.172$. For $\lambda_{\text{effective}} = 3720 \text{ \AA}$ there is complete agreement with Abbot's spectro-bolometric measurements which extend to $\cos \theta = 0.243$. The deduced mean brightness variation of the granulation amounts to $\Delta m = \pm 0^m.033$ in the centre of the disc for $3720 \text{ \AA}$. Analysis of the course of the brightness variation in the centre of the disc shows the elements of the granulation have a mean magnitude of $5''$; as a result of statistical distribution fluctuations these structure elements produce larger groups of mean magnitude $14''$. The corrected mean brightness variation of $5''$ granulation at the centre of the sun is $\pm 0^m.07$; the mean temperature difference deduced therefrom between the bright and dark and bright regions is about 110° . In small surface regions the brightness variations about the local mean brightness often show a small deviation from a normal distribution; the form of the frequency distribution of the variations leads to resolution into two Gaussian distributions about mean values which differ by $0^m.070$. The mean observed brightness variation

decreases from centre to edge of the disc according to the equation $\Delta m(\theta) = 0^m \cdot 0327 - 0^m \cdot 0032 (\sec \theta - 1)$. When the effects of finite resolution and air movement are taken into consideration it is found that the mean brightness variation of the granulation remains constant over the whole disc within the limits of experimental error. J. E. K.

3600. Two Solar Eruptions. J. C. Dobbie, W. Moss and A. D. Thackeray. *Roy. Astron. Soc., M.N.* 98. pp. 606-612, June, 1938.—The Solar Physics Observatory, Cambridge, and the Cavendish Laboratory Field Station collaborate for (a) photometric measurements of solar H α radiation during eruptions compared simultaneously with ionosphere radio-echoes reflection coefficients. (b) for detection of u.v. continuous light increase. The technique and observing instruments are described. The eruptions were on 1938 March 31 and April 13. The first indicates that the time of a fade-out depends largely on the frequency used; the maximum disturbance velocity must be nearly that of light. The two effects indicate an increase of u.v. radiation rather than a stream of high-speed particles. Both eruptions show that higher peak intensity has greater effect on the ionosphere than extended area; the short-lived phenomenon with a well-defined maximum was accompanied by a similarly sharp ionospheric disturbance, and the long-lived eruption of wide area had no pronounced maximum but had ionospheric conditions that were generally disturbed. A. S. D. M.

3601. Changes of Strong Fraunhofer Lines from Centre to Edge of Sun's Disc. J. Houtgast. *Zeits. f. Astrophysik*, 16. 1-2. pp. 43-50, 1938.—In continuation of a series of observations and measurements previously reported [see Abstract 3550 (1936)] the intensity profiles of 20 strong Fraunhofer lines of Ca, Ca⁺, Na, Mg and Fe are measured at 7 different parts of the sun's disc from the centre to within 0.005R of the edge of the disc. The results are communicated in an abbreviated form; a full description and discussion will be published later. In the case of the lines Mg5184, Ca 4227 and Ca⁺3934 the results are compared with those of other observers. J. E. K.

3602. New Anomalous Effect in the Short-Wave End of the Solar Spectrum. S. Rodionov, E. Pavlova, and N. Stoopnikov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 1-2. pp. 55-57 and pp. 59-60, 1938. *In English*.—Measurements were made at Mt. Elbruz in 1935 at 4250m. of the solar intensity simultaneously for four wave-lengths for successive zenithal distances (z). The results are shown graphically. With z between 25° and 60° the results agree with the general equation for the distribution of energy at the short-wave end of the solar spectrum and give the thickness of the O₃ layer 0.25 cm. Between 60° and 70° anomalous distribution is found probably due to anomalous refraction of short waves (<3200Å) in the O₃ layer which may be expected near the long-wave boundary of the Hartley band. Measurements were also made by S. Rodionov and E. Pavlova at a height of 2200m. during the Elbruz expedition, and the effect was observed for wave-lengths down to 2980Å. At this lowest wave-length two minima were observed indicating that absorption occurs also at another layer (probably Kennelly-Heaviside layer). For lower wave-lengths the minimum occurs at smaller zenithal distances of the sun. This effect and the anomalous morning course of sunlight appear to be governed by the same general mechanism. R. S. R.

See also Abstract 3590.

GEOPHYSICS.

HYDROSPHERE, PHYSICS OF THE.

3603. Dynamical Oceanography. G. F. McEwen. *Am. Phil. Soc., Proc.* 79. 2. pp. 145-166, 1938.—This paper begins with a general historical review of researches on oceanic circulation conducted since the introduction, in the early part of the nineteenth century, of Maury's international cooperative plan of making and reporting ocean observations. The treatment throughout is non-mathematical and an attempt is made to furnish the reader who is not a specialist in the field with a comprehensive survey of progress already made and of problems to be solved. Both theoretical methods of calculating ocean currents from observations of wind, temperature and salinity, and observational methods of determining ocean currents are considered. Special attention is given to errors made in earlier attempts to apply to the ocean theories based upon laboratory experiments. Revisions of these earlier methods and the rapid developments leading to the more satisfactory modern ones are briefly outlined. Then, following an introductory classification of the various forces that generate and maintain oceanic circulation there are general outlines of various methods of applying the principles of physical hydrodynamics to problems of oceanic circulation. There is also an elaboration of the theory of eddy-viscosity and turbulence which processes account for rapid diffusion of momentum, heat and chemical properties. Next a method is explained of calculating the circulation that would account for the departure of actual surface temperatures from their normal values. The explanations mentioned above are restricted to the fundamental part of the mathematical-physical treatment of oceanographic problems involving only the simplest conditions and essential methods. The paper concludes with a supplementary discussion of revisions made necessary by a more detailed consideration of actual conditions such as nearness to coastal boundaries and irregularities in depth. AUTHOR.

LAND, PHYSICS OF THE.

3604. Theory of Plastic Buckling with its Application to Geophysics. P. P. Bijlaard. *K. Akad. Amsterdam, Proc.* 41. 5. pp. 468-480, 1938. *In English.*—A mathematical investigation of buckling under plastic conditions throws light upon the occurrence of folding in rocks of the earth's crust. W. A. R.

3605. Measurement of Sand Storms. R. A. Bagnold. *Roy. Soc., Proc.* 167A. pp. 282-291, Aug. 5, 1938.—Reference is made to results obtained earlier relating the wind and ground surface conditions with the mean flow of sand over open country [see Abstracts 584 (1937) and 116 (1938)]. Observations were made in the Egyptian desert during two sand storms. The apparatus used and its method of operation are described. The results confirm those obtained in the wind tunnel making allowance for the difference in grain size of the sand. Curves are given showing (1) the rate of sand movement over the surface of an eolian sand accumulation carried by a wind of any velocity as measured at a standard height of 1m. above the surface, and (2) the grading of a sand in process of transport. R. S. R.

METEOROLOGY.

3606. Vertical Distribution of Ozone in the Atmosphere. V. H. Regener. *Zeits. f. Physik*, 109. 9-10. pp. 642-670, 1938.—A new balloon method is described for estimating the vertical distribution of O_3 in the atmosphere, which is based on the recording of the u.v. solar spectra at different altitudes, and which in contrast to the earlier data is uninfluenced by scattered light and atmospheric effects. The spectra were evaluated by specially designed photometric methods. Two balloon ascents led to the discovery of a minimum for the O_3 pressure in the troposphere, and considerable periodical and spatial fluctuations in the content of O_3 in the lower atmosphere were established. The above phenomena receive very thorough discussion, and an interpretation is given for the vertical distribution in relation to the chemical decomposition of ozone in the troposphere and at the earth's surface. H. H. Ho.

3607. Variations of Solar Constant and their Relation to Weather. M. M. Paranjpe. *Roy. Meteorolog. Soc., J.* 64. pp. 459-474; *Disc.*, 474-476, July, 1938.—The determinations of the solar constant obtained by the Astrophysical Observatory of the Smithsonian Institute during the last thirty years are discussed, with results which point to the conclusion that the observed variations are mainly due to the defects in the methods of determining the solar constant. If this conclusion is accepted the subsequent work based on the supposed variability of the solar constant is not valid. AUTHOR.

3608. Intensity of U.V. Radiation from the Sky in Iraq. W. P. Kennedy. *Roy. Meteorolog. Soc., J.* 64. pp. 489-494; *Disc.*, 494, July, 1938.—Hæmatological investigations in Baghdad suggested that the climate altered the blood of normal persons as compared with Britain, and as part of the analysis of the climatic factors, day-to-day measurements were made of the u.v. component of northern sky shine, using Owens's instrument. In this a Chance No. 14 filter is separated from a sheet of photographic paper by a graded series of tubes, giving a scale of 13 arbitrary values from 1 to 204. The upper end of the scale is much more open than the lower, and this must be considered a disadvantage in very bright conditions such as the Iraq summer. The instrument is exposed for 24 hours at 45° to the zenith pointing north. The daily measurements from Aug., 1936, to Aug., 1937, are given in graphic form, and also as monthly means. With the latter, various other meteorological data are tabulated to show the trend and range of climatic variation, and to indicate some of the major causes of fluctuation in the u.v. values. The direction of influence of these variables is discussed briefly, but integration of the factors is not attempted. The paper is preliminary; further studies are in progress. AUTHOR.

3609. Atlantic Flight and its Bearings on Meteorology. F. Entwistle. *Roy. Meteorolog. Soc., J.* 64. pp. 355-389, July, 1938.—The development of long-distance air routes in recent years has necessitated the expansion of meteorological services in different countries and, in certain cases, the establishment of organised meteorological services where none existed previously. A position is thus being approached gradually in which an organised system of meteorological observations will exist over the greater part of the globe, and material for a study of world meteorology, to an extent hitherto unknown, will be available to investigators. In the case of the long trans-ocean air routes which are projected

a special study of prevalent meteorological conditions from the point of view of aviation is necessary. The fundamental data in such cases are supplied by observations from selected ships which bridge the gaps between the fixed continental observing stations and so contribute to the world network. Certain of the meteorological problems which have arisen, owing to the proposed establishment of a regular trans-Atlantic air service, are discussed both from the point of view of aviation requirements and also as contributing to meteorological knowledge. A brief account is also given of the organisation devised to ensure an adequate meteorological service for trans-ocean flights. AUTHOR.

3610. Application of Wet-Bulb Potential Temperature to Air Mass Analysis. Part IV. E. W. Hewson. *Roy. Meteorolog. Soc., J.* 64. pp. 407-418; *Disc.*, 419-420, July, 1938.—This paper describes:—

(a) The moisture content of subsiding polar continental air over North America, under conditions when there was no likelihood of an increase in the moisture content due to precipitation from overrunning air. Two situations of this type are discussed, and no evidence is found of any appreciable increase above 850 mb. (b) The degree of homogeneity in polar continental air masses. The vertical distributions of wet-bulb potential temperature θ' as observed nearly simultaneously at adjacent stations within an air mass are discussed in relation to their effect on the accuracy of computations of subsidence. (c) The vertical velocity of air in the warm sector of a depression. It is shown that in the warm sector considered, the ascent of the air near the surface was nearly twice as rapid as that at about 600 mb. The vertical velocity of the surface air was of the order of 4 cm./sec., and that of the air at about 600 mb. was of the order of 2 cm./sec. (d) The effect of turbulence in the air near the surface. The changes of temperature and moisture content in the surface layers of a moving air mass are discussed in the light of the theory of turbulence, as developed by Richardson and Taylor. [For Part III see Abstract 3486 (1937).] AUTHOR.

3611. Variation of Pressure Accompanying a Distortion of Air Flow. A. F. Crossley. *Roy. Meteorolog. Soc., J.* 64. pp. 477-480; *Disc.*, 480-481, July, 1938.—It is known that certain meteorological stations frequently record a mean sea level pressure which is lower than that which would be expected from the general run of the isobars by amounts up to about 1 mb. These stations are located in over-exposed situations, such as the tip of a promontory, where the wind speed may be appreciably in excess of the speed in an ideal exposure. In steady motion, the flow of wind over or round the promontory conforms with Bernoulli's equation, which gives a relation between pressure and velocity at points on the same stream line. It is shown that a reasonable increase of wind speed above normal produces a decrease of pressure of the right magnitude. The equation is applied in the first instance to steady frictionless motion, but it is shown that the results apply with little variation to the flow of surface air, as modified by friction. AUTHOR.

3612. Development in Field of Barometric Pressure. R. C. Sutcliffe. *Roy. Meteorolog. Soc., J.* 64. pp. 495-504; *Disc.*, 505-509, July, 1938.—As geostrophic winds are non-divergent it is shown that pressure changes can be determined only by the field of geostrophic departure. Consideration is first given to certain popular conceptions of pressure changes. These are seen to be invalid without considering the dynamical processes involved. Thereafter it is pointed out that, as

geostrophic departure is proportional to horizontal acceleration, the theory of depressions can be approached through studying the departure of the velocity from the gradient value. This is done by expanding the acceleration into its partial derivatives and examining each separately. Such an investigation shows that the isallobaric effects alone are unable to explain pressure developments, and it is suggested that all terms may be significant. The effect of the vertical space derivative is specially stressed.

A. E. M. G.

3613. Wind Structure Beneath Warm Fronts. C. S. Durst.

Roy. Meteorolog. Soc., J. 64. pp. 516-522; *Disc.*, 522, July, 1938.—Fourteen cases of warm fronts passing over the British Isles were selected and the winds observed by means of pilot balloons were compared with the geostrophic winds at various heights up to 10,000 ft. and at distances ranging up to 500 miles. The results were combined in order to get an average value of the departure from the geostrophic wind at certain points. An evaluation is made of the second order terms in the equations at these points, and it is concluded that in this region of a depression the departures from the geostrophic wind are primarily dependent on (a) the isallobaric term and (b) a term involving the velocity of the cold air away from the incoming warm air and the variation in that direction of the velocity of the air at right angles to that direction.

AUTHOR.

3614. Lunar Atmospheric Tide at Accra. S. Chapman.

Roy. Meteorolog. Soc., J. 64. pp. 523-524, July, 1938.—The lunar atmospheric tide has hitherto been determined at two stations on the African continent, Helwan and Kimberley. A new determination has now been made from about three years' bi-hourly data for the tropical African station, Accra ($5^{\circ} 33' \text{ N.}$, $0^{\circ} 12' \text{ W.}$). The annual mean amplitude of the lunar tidal variation of pressure is found to have the rather small value 45 microbars; the phase angle, 72° , implies that the high (lunar) tide in the atmosphere over Accra occurs about half an hour after the moon's transit; this phase lag is quite normal.

AUTHOR.

***3615. Atmospheric Exploration by Radio-Sounding Balloons.**

H. A. Thomas. *Roy. Soc., Proc.* 167A. pp. 227-250, Aug. 5, 1938.—Existing methods of exploring the atmosphere by radio-sounding balloons are reviewed briefly, and it is explained that arrangements involving variation of radio frequency are not likely to be satisfactory due to the wide frequency band required and the possibility of appreciable interference. Furthermore, methods involving signalling codes are complex and expensive, and the delineation of the signals at the receiver presents considerable difficulty. The essential features of an original method of exploration are described; in this method a signal of fixed radio frequency is employed and each meteorological instrument produces a continuous variation of modulation frequency. Calibration of the meteorological parameters in terms of frequency can be made independently of the radio transmitter, and measurement of these audio frequencies at the receiver is comparatively easy. The pressure- and temperature-measuring instruments are both arranged to produce variation of modulation frequency without the use of mechanical linkages. The cost of the apparatus is comparatively low, and reproduction in large quantities is possible. The results obtained from a number of experimental ascents are analysed and it is shown that a high degree of reliability and accuracy is obtainable. Using the present balloon, observation of both pressure and temperature up to an altitude of about 10 km. is obtained, the accuracy of the pressure

and temperature determinations being about 5 mb. and 1° C. respectively.

AUTHOR.

***3616. Nomogram Method of Humidity Control. R. G. Bateson.** *Engineering*, 146. p. 57, July 8, 1938.—The apparatus described has arms attached to Bourdon tubes connected to wet- and dry-bulb thermometers. Each arm carries a roller at the end and a light straight edge member rests on these rollers. The mid-point of the straight edge member is attached to an arm pivoted to move over the nomogram humidity scale. For control purposes the humidity pointer moves between two air valves or electric contacts so that if the humidity falls below a predetermined value steam or water vapour is admitted to the air and when above a fixed value heating or drying apparatus is employed.

R. S. R.

3617. Evaporation Over Catchment Areas. D. Lloyd. *Roy. Meteorolog. Soc.*, J. 64. pp. 423–437; *Disc.*, 437–444, July, 1938.—Some of the most authentic data of the general rainfall over British drainage areas and the run-off in annual periods are marshalled. The difference between these observed quantities of water—i.e., the losses in annual periods from all causes—is fundamentally accepted from other research to be principally the effect of evaporation including evapo-transpiration. The paper examines the variation in the annual total loss over eight drainage areas by a statistical method. It is postulated that loss is a joint function of meteorological elements and the geological formation penetrated by any rain water; further, that in the present stage the joint functional causation can be simplified to one of separate functions. Thus, it is assumed that the variations in loss can be associated with the rainfall providing the opportunity for evaporation, with the temperature, with the sunshine, and (as following the primary loss in the zone of aeration, influent seepage may provide a flow in the zone of saturation which later may provide a deferred opportunity for evaporation from the capillary fringe and effluent seepage from ground water) with the geological formation. Regressions of loss on the available postulated controls have been inferred. By inductive reasoning, an equation is found approximately representing the observations over the eight areas, by which the annual loss expected on account of various influences can be estimated.

AUTHOR.

3618. Partition of a Region into Rainfall Districts. T. E. W. Schumann and W. L. Hofmeyr. *Roy. Meteorolog. Soc.*, J. 64. pp. 482–487; *Disc.*, 488, July, 1938.—A method is here presented for dividing any region into a number of rainfall districts on the basis of seasonal distribution of precipitation. This is accomplished by drawing on a map of the region two systems of lines of equal “phase” and equal “relative amplitude,” which are measures respectively of the epoch of maximum rainfall and of the normal fluctuation which occurs in the course of a year. A map of the Union of South Africa is reproduced showing rainfall districts obtained by this method.

AUTHORS.

3619. Water Vapour in Stratosphere and Upper Troposphere. D. Brunt and A. K. Kapur. *Roy. Meteorolog. Soc.*, J. 64. pp. 510–514; *Disc.*, 514–515, July, 1938.—Having shown that the humidity mixing ratio should remain constant within the stratosphere, the authors derive a simple formula in terms of the vapour pressure e and the pressure p at the tropopause whereby the total water vapour content of the stratosphere may be calculated. Computations carried out for the northern hemisphere in order to determine the level above which there is 0.3 mm. precipitable water, indicate that whether complete or only 50% saturation be assumed

in the upper troposphere, the level coincides with an isothermal surface. Results are tabulated and also represented diagrammatically. Some reference is made to the effect the small quantities of water vapour in the stratosphere as revealed by the present investigation, are likely to have on equilibrium conditions in the O_3 layer. A. E. M. G.

3620. Relation of Brightness of Night Sky to Zenith Distance.

J. Rudnick. *Astrophys. J.* 87. pp. 584-588, June, 1938.—Two all-night series of observations of the brightness of the night sky were obtained, neither of which shows a diurnal variation, in either the red or the blue region of the spectrum. Curves of intensity plotted against zenith distance show no systematic change of colour with zenith distance, although extinction tends to make the sky appear redder toward the horizon. Mean curves are given for determining the intensity of the light of the night sky at any altitude from that at any other altitude. AUTHOR.

3621. Absorption of Light by the Atmosphere. A. Vassy and

E. Vassy. *Comptes Rendus*, 206. pp. 1893-1895, June 20, and 207. pp. 63-65, July 4, 1938.—The spectral absorption of large thicknesses of the lower atmosphere in the near infra-red and visible was measured by a photographic method involving taking spectrograms of a powerful tungsten filament source at distances of 24 and 5 km., and comparing the spectra with calibration spectra obtained from a standard tungsten filament lamp. The advantages of the method are enumerated. For the u.v. a modified method employing a H_2 tube as source [see Abstract 3618 (1934)] is used. To measure the absorption of the total atmosphere spectrograms of Vega and Sirius are taken at different zenith angles, and compared with calibration spectra as in the lower atmosphere measurements. Measurements have been performed for several months at an altitude of 1635m. at Ifrane (Morocco). Spectral absorption curves were taken on nine clear nights in July, August and September. The curves fall into two groups; in the first, the difference between the curves is constant for all wave-lengths; in the second the differences are irregular. In the first group, much of the absorption is shown to be due to the characteristic absorption bands of H_2O -vapour, O_2 and O_3 . Added to this is an absorption probably best explained as due to molecular diffusion according to the Rayleigh-Cabannes formula; and there is also an absorption, differing from night to night, but constant for all wave-lengths and probably due to particles in the air sufficiently large to absorb non-selectively. In the second group the absorption was greater, and H_2O bands were more prominent. D. H. F.

3622. Scattering of Light by Particles in the Air. H. Grisollet.

Comptes Rendus, 206. pp. 1912-1914, June 20, 1938.—An investigation of the scattering of light by particles suspended in the air in the neighbourhood of the earth has been carried out at Montsouris Observatory during the period Jan., 1934, to March, 1936. The relationships found to exist between the intensity and state of polarisation of the scattered light, the angle of scattering, and the concentration of particles, are described. [See Abstract 3564 (1936).] W. H. Wal.

3623. Formation of Free Atoms of Sodium in the Upper Atmosphere. P. Bernard.

Comptes Rendus, 206. pp. 1669-1672, May 30, 1938.—The mechanisms whereby free Na atoms are formed in the upper atmosphere (60 km.) at a relatively high temperature (150°) are discussed. NaCl is present probably as a result of vaporisation of sea water and it reacts with atomic H to give free Na atoms. The atomic

H may be formed by decomposition of water or more probably by the reaction $N_2 (A^3\Sigma) + H_2O \rightarrow N_2 (X^1\Sigma) + OH + H$. Spectroscopic evidence supports the latter reaction. [See following Abstract.] W. R. A.

3624. Bands of the OH Molecule in the Spectrum of the Night Sky. G. Déjardin and R. Bernard. *Comptes Rendus*, 206. pp. 1747-1748, June 8, 1938.—The hypothesis that in a certain region of the upper atmosphere atomic H is formed and can react [see preceding Abstract] is applied in considering certain portions of the spectrum of the night sky. Some 30 lines in the spectral ranges 3060—3245 Å. and 3420—3520 Å. can be attributed as due to the OH molecule by comparison with spectra of OH produced in the laboratory. The differences in the relative intensities of the lines in the two spectra (night sky and laboratory OH) may arise from different modes of excitation of OH. W. R. A.

3625. Height of Layer whence D Rays are Emitted and Origin of Na Atoms in this Layer. G. Déjardin and R. Bernard. *Comptes Rendus*, 207. pp. 81-83, July 4, 1938.—Reasons are given for thinking that the height of the layer, 130 km. obtained from Cabannes and Dufay's formula may have a minimum of 60 km. It is considered that the Na atoms are more probably of terrestrial origin and originate by upward diffusion of NaCl from the oceans and the decomposition at high temperatures and low pressures of these molecules. Volcanic eruptions may have helped by the presence of Na_2O in the form of dust which persists for a long time at high levels. The presence of this dust is indicated by changes of solar radiation and atmospheric absorption between 1883 and 1914 with four periods having a perturbation of 2 to 5 years. **Errata**, *ibid.* p. 384, Aug. 8, 1938. [See Abstract 1552 (1938).] R. S. R.

3626. Atmospheric Optical Phenomena in North-East Land. R. Moss. *Roy. Meteorolog. Soc.*, J. 64. pp. 451-458; *Disc.*, 458, July, 1938.—A record is given of the various atmospheric optical phenomena observed during the ten months' occupation of a station on the inland ice of North-East Land (80° N., 20° E.) by the Oxford University Arctic Expedition, 1935-36. As well as the more common mock-suns and mock-moons, several complexes were observed, notably on June 6, 1936, when the comparatively rare Parry arc occurred. There were also many instances of a phenomenon which has occasionally been described previously, but which has not been distinguished from others, with which it usually occurs simultaneously. It takes the form of a pair of *white* mock-suns on or near the visible horizon; they do not appear to be essentially connected with the usual "prismatic" halo phenomena. The name "hypohelia" is proposed for them. AUTHOR.

See also Abstracts 3602, 3605, 3629, 3672.

SEISMOLOGY.

3627. Anomalous Dispersion of Elastic Surface Waves. K. Sezawa. *Tokyo Univ. Earthquake Research Inst.*, Bull. 16 pp. 225-232, June, 1938. *In English*.—From a mathematical investigation it was found that while the dispersion of Love waves is normal, the dispersion of Rayleigh waves in certain special conditions of stratification is anomalous. This condition can exist for a certain range of wave-lengths transmitted through the surface layer if the velocity of bodily waves in the upper layer is greater than that in an adjacent layer of greater density. For this kind of dispersion the propagational velocity of surface waves exceeds

that for transverse waves in the upper or lower media. Except for a few conditions the distribution of displacements with depth does not differ greatly from that of the usual Rayleigh waves. R. S. R.

See also Abstract 3505.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

3628. Variation of Electrical Conductivity of the Atmosphere with Height. D. C. Rose. *Canad. J. of Research*, 16, Sect. A. pp. 107-130, June, 1938.—The conductivity of the atmosphere has been measured during flights in aeroplanes near ground level and up to about 16,000 ft. Seven flights were made during the autumn and winter of 1936-1937. The Gerdien type of conductivity apparatus was used. An attempt was also made to measure potential gradients by the radioactive collector method. This method was impracticable, probably because of charges acquired by the aeroplane. It did, however, serve to indicate the presence of intense local space charges such as charged clouds. On one flight, observations were taken near a thunderstorm, but owing to difficulties in interpretation no conclusions regarding the exact nature or location of the charges could be drawn. The conductivity increased rapidly with height in a manner in general agreement with the data of other observers. Positive and negative conductivities were found to be equal, within the experimental error, at heights between about 1000 and 10,000 ft. At higher altitudes the negative conductivity was greater than the positive. The presence of clouds and frontal discontinuities usually caused a reduction in continuities. AUTHOR.

3629. Mechanism of Thundery Conditions at Karachi. S. Mal and B. N. Desai. *Roy. Meteorolog. Soc.*, J. 64. pp. 525-537, July, 1938.—Weather conditions and aeroplane ascents at Karachi between June 22 and July 2, 1936, have been examined for understanding the mechanism of thundery conditions which prevailed there during that period. It is observed that thundery conditions occurred when the characteristic monsoon inversion was absent and there was a sufficiently deep layer of air which when raised to a certain level either by insolation, arrival of sea air, or convergence of winds, released an appreciable amount of energy of latent instability. AUTHORS.

3630. Magnetic Anomalies Around Volcanic Craters. T. Nagata. *Tokyo Univ. Earthquake Research Inst., Bull.* 16. pp. 288-299, June, 1938. *In English.*—The method employed in obtaining observations of magnetic declination around the crater of the volcano Mihara is explained and the results are tabulated. The anomalies obtained are supposed to be due to singularities in the topography of the crater and probably due to induced magnetism in the rocks with large magnetic susceptibility around the crater. The susceptibility is calculated from the observed data. It is shown that the earth's magnetic field in the island has an anomalous distribution almost equal to the magnetic field due to a bar magnet placed in the centre of the volcano coaxially with the normal magnetic meridian. R. S. R.

RADIOACTIVITY.

3631. Excitation Mechanism in Atomic Nuclei. L. Goldstein. *Comptes Rendus*, 206. pp. 1880-1882, June 20, 1938.—The mean life τ of an excited state is calculated from the viscosity of the intra-nuclear gas. For a nucleus containing A heavy particles, $\tau = 1.43 \times 10^{-23}$ A sec., which, in the case of light nuclei, is of the same order as the time of passage of a heavy particle across the diameter. It is thought that the intra-nuclear gas model furnishes lower limits for the values of τ . G. C. E.

3632. Excitation of Nitrogen Nuclei by Rapid Neutrons through Paraffin. J. Thibaud and P. Comparat. *Comptes Rendus*, 206. pp. 1963-1965, June 27, 1938.—Neutrons from $\text{Be} + \text{Rn}$ were passed through a variable thickness of matter (paraffin, Pb, Na, Fe, Bi, etc.) and then allowed to fall on $^{14}_7\text{N}$. A variable number of the $^{14}_7\text{N}$ nuclei were disintegrated ($^{14}_7\text{N}$, $n \rightarrow ^{11}_5\text{B}$, α). The effect is specially marked with paraffin. When the number disintegrated is plotted against thickness (of paraffin) the curve obtained is not smooth, but shows a number of alternate maxima and minima. These diminish absolutely, not relatively, as the thickness increases. Slow neutrons are not concerned as interposition of a Cd screen does not alter the positions of the maxima and minima. The cause is discussed, and considered to be probably resonance. C. A. S.

3633. Excitation Functions of the (α, n) -Transformations of N, Al and A. E. Fünfer. *Ann. d. Physik*, 32. 4. pp. 313-335, June, 1938.—With the energetic α -rays of Th C the excitation curves of the (α, n) -transformations of N, Al, and A were investigated. The homogeneity of the bundle of rays is sufficiently good to analyse the resonance positions situated near each other. The observation of the neutrons was carried out in proportional counting tubes which were coated inside with B, whereby the neutrons previously in layers of paraffin were checked in thermal velocity. The excitation curves consist almost exclusively of resonance regions. In the regions lying between the yield of neutrons is very small. The upper limit of the extent of the resonance level is about 50 kV. It must be assumed that the effective extent is considerably smaller. The mean distance between the levels lies between 100 and 300 kV. Especially important is the fact that in the case of N sharp resonances appear with energies above the height of the potential threshold. This is in favour of the idea of the intermediate nucleus as formulated by Bohr. On comparison of the experimentally found term distances with the theoretical values no agreement is found. The fact that the term distances for Al are not smaller than for N may be understood on the basis of selective rules which limit the possibility of the excitation level in the intermediate nucleus P^{31} formed from Al. Further a comparison is made between the (α, n) - and the (α, p) -transformation of Al and this shows that in both cases the same resonance positions frequently occur. Thus the greater yield of A relatively to N may be explained; perhaps with N the probability of penetration of the α -particles is greater. With A no (α, p) -process exists, whilst with N the destruction of the excited intermediate nucleus is caused much more frequently by the emission of a proton than of a neutron. J. J. S.

3634. Theory of Excitation Functions on Basis of Many-Body Model. E. J. Konopinski and H. A. Bethe. *Phys. Rev.* 54. pp. 130-138, July 15, 1938.—The theory of transmutation functions for charged

particles is examined in the light of recent developments in nuclear theory. It is found that ignoring all factors besides the penetrability of the incident particle is justifiable only for processes without effective competition. For these, the usual applications of the Gamow-Condon-Gurney theory must be modified to include the influence of incident particles with non-vanishing orbital momentum which causes a continued rise of the yield for energies greater than the Coulomb barrier. For processes subject to effective competition, the comparative density of residual states available to each alternative process is important in determining relative yields. The densities of the states are calculated on the basis of the liquid drop model for the nucleus and a table is obtained giving the relative probabilities of neutron and charged particle emissions. The overwhelming factor in favour of neutron emission by heavy nuclei seems to be confirmed by experiment. The shape of an excitation curve expected for the less probable of two processes is shown. Finally the effect of selection rules in the yield curves of reactions involving very light nuclei is considered. Special cases are discussed.

AUTHORS.

3635. Periods of Radioactive Silver Isotopes. A. Moussa and H. Laurent. *J. de Physique et le Radium*, 9. pp. 245-250, June, 1938.—An improved apparatus for measuring the period of radioactive ^{108}Ag obtained by bombarding Ag with slow neutrons is described, and the necessary corrections to the observations are given. Calculations of the most accurate values of the periods from the measurements obtained are reported in detail. The values found are : ^{108}Ag , 150 ± 2 sec ; ^{110}Ag , 23.9 ± 1 sec.

N. M. B.

3636. Long-Period Radioactivity in Ag, Cs and In Activated by Slow Neutrons. K. Alexeeva. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 8. pp. 553-555, 1938. *In English*.—Previous work [see Abstract 603 (1938)] is extended to cover the bombardment of a great many elements by slow neutrons for a period of 6 to 7 months. Long-period radioactivity was found to be produced in Ag, Cs and In, the half-lives being estimated at about 2 y., 1 y. and 60 d. respectively.

F. C. C.

3637. Absorption and Coincidence Experiments on the Radiations from the Radioactive Sodium, Na^{24} . N. Feather and J. V. Dunworth. *Cambridge Phil. Soc., Proc.* 34. pp. 442-449, July, 1938.—The radiations from Na^{24} have been examined by the absorption and coincidence methods and evidence has been obtained for the conclusion that the energy spectrum of the β -particles is a simple continuous spectrum with an upper limit at 1.40×10^6 eV, and that the emission of γ -radiation after the particle disintegration takes place almost always as a cascade process in which at least two quanta are involved, and very rarely by a single transition to the ground state.

AUTHORS.

3638. Disintegration of Boron. I. Zlotowski. *Comptes Rendus*, 207. pp. 148-150, July 11, 1938.—In a note on the disintegration of B on bombardment with α -particles the relative yield of protons and deuterons is discussed ; the ratio is found to be approximately as 100 to 3. The significance of this is considered.

G. O. B.

3639. New Transformation Product of Long Life in the Trans-Uranium Series. O. Hahn, J. Meitner and F. Strassmann. *Naturwiss.* 26. pp. 475-476, July 22, 1938.—Irradiation of U within paraffin with neutrons for some months gave rise to a new transformation product with a half-life of 60 days. The genetic relationships of this product have not

yet been definitely proved, but it is probably an eka-iridium (atomic number 95) which is formed from eka-osmium (atomic number 94) of half-life 5.7 hr. A. J. M.

3640. Artificial Disintegration of Th with Neutrons. L. Meitner, F. Strassmann and O. Hahn. *Zeits. f. Physik*, 109. 7-8. pp. 538-552, 1938.—It is shown that four disintegration series result from the bombardment of Th with fast or slow neutrons. One series results from an absorption process, the remaining three series, which are isomeric, being due to the abstraction of an α -particle. The four β -activities have half-value periods of 26 min., <1 min., 15 min. and ~ 4 hr. respectively. The processes may also be produced by bombardment of Th with the 2.5 eMV neutrons from the D-D reaction. F. C. C.

3641. Yield of α -Particles from Be Bombarded by Protons. G. T. Hatch. *Phys. Rev.* 54. pp. 165-171, Aug. 1, 1938.—Experiments to determine the excitation function of the reaction ${}_4\text{Be}^9(p, \alpha){}_3\text{Li}^6$ for proton energies up to 400 kV are reported. It is shown that the yield is very large, ca. 4×10^{-6} α -particle per proton at 400 kV, but the derived thin target curve shows a marked flattening from the exponential form observed at lower voltages. The cross-section is nearly constant above 300 kV, and has a value of about 2.3×10^{-25} cm². AUTHOR.

3642. Energy Change in Be-Li Transmutation by Proton Bombardment. S. K. Allison, L. S. Skaggs and N. M. Smith, Jr. *Phys. Rev.* 54. pp. 171-175, Aug. 1, 1938.—The very high yield of α -particles from the reaction ${}_4\text{Be}^9(p, \alpha){}_3\text{Li}^6$ has made it possible to measure their energies by deviating a beam through 90° in an electrostatic field. A steady source of high voltage, which could be measured to 0.1% up to 40,000 V, was used to deflect the α -particles. Two experiments are reported in which the Be was bombarded by 320 kV and 383 kV protons, respectively. The energy distribution curves of the alphas show a sharp high energy limit, and this limit increases with bombarding energy of the protons. The experiment shows that the energy balance of the reaction is 2.152 ± 0.04 eMV, corresponding to $2.310 \pm 0.04 \times 10^{-3}$ atomic weight unit. This establishes the difference in mass between Be^9 and Li^6 as 2.99804 ± 0.00009 . If we assume that of the two, the mass of Li^6 is more accurately known, and adopt Livingston and Bethe's value of 6.01686 ± 0.00020 , the experiment shows that the mass of Be^9 is 9.01491 ± 0.00025 . AUTHORS.

3643. Anomalous Scattering of α -Particles. H. S. W. Massey and C. B. O. Mohr. *Cambridge Phil. Soc., Proc.* 34. pp. 498-501, July, 1938.—Recent experiments of Mohr and Pringle [see Abstract 2524 (1937)] on the anomalous scattering of α -particles in H_2 , D_2 and He have revealed the existence of appreciable deviations from Coulomb's law at quite large distances. Ordinary electrostatic polarisation of the colliding nuclei has been suggested as a mechanism to account for this. Since the structure of the deuteron is known reasonably well its polarisability can be calculated. The α -particle has a more compact structure than the deuteron, thus its polarisability is probably less than that of the deuteron. The polarisability of the α -particle can be obtained from measurements of the scattering of α -particles in He, and this value can be compared with the deuteron value as a limit. The results of the test are entirely unsatisfactory, showing that classical electrostatic polarisation cannot by itself explain anomalous scattering. G. O. B.

3644. Variation of Ionisation with Range of α -Particles, Protons, Deuterons and ^3H Particles. J. C. Bower. *Cambridge Phil. Soc., Proc.* 34. pp. 450-458, July, 1938.—Photometrical determinations of the variation of density along photographs of expansion chamber tracks have enabled the positions of maximum ionising efficiency for single α -particles, protons, deuterons, and ^3H particles to be determined. The maximum rate of ionisation for an α -particle in air occurs when it has a residual range of 3.7 mm. in standard air. The distance of the position of maximum ionising efficiency from the end of the particle range is shown to be approximately in the ratio of the particle mass in the case of the particles, ^1H , ^2H and ^3H . AUTHOR.

3645. Theory of β -Decay. M. H. Hebb. *Physica*, 5. pp. 701-704, Aug., 1938. *In English*.—The new method of Crane and Halpern [see Abstract 2843 (1938)] for detecting the neutrino is discussed. For this method to be valid it is necessary that the β -disintegration be adiabatic. Theoretical arguments that this is so are advanced. AUTHOR.

3646. Production of Positron-Electron Pairs during the Passage of β -Particles through Matter. N. Feather and J. V. Dunworth. *Cambridge Phil. Soc., Proc.* 34. pp. 435-441, July, 1938.—The method of coincidence counting has been applied to an investigation of the possible production of positron-electron pairs by the high energy β -particles from a source of uranium X in absorbers of aluminium, brass and lead. The results are not inconsistent with the high values recently reported for atomic cross-sections for the effect, nor with the suggestion that the atomic cross-section is proportional to the first power of the atomic number rather than the second. Suggestions are made for the use of the β -particles from artificially radioactive substances in an attempt to increase the sensitivity of the method. AUTHORS.

3647. Probability of Pair Creation in Kr by γ -Rays. L. V. Grošev and I. M. Frank. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 7. pp. 419-422, 1938. *In English*.—Using a special hermetically sealed cloud chamber, the creation of pairs of positrons and electrons in Kr by the γ -rays from Rd-Th is examined. The results are divided into two groups covering the energy intervals 0.5-1 eMV and greater than 1 eMV respectively. Methods are devised for allowing for spurious pairs due to electrons which have suffered single nuclear scattering. The effective cross-section for pair production is found to be in approximate agreement with the theory of Jaeger and Hulme. [See following Abstract.] F. C. C.

3648. Angular Distribution of Pairs in Kr. L. V. Grošev and I. M. Frank. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 1-2. pp. 49-54, 1938. *In English*.—Continuing previous work [see preceding Abstract] examination is made of the angular distribution of pairs in Kr produced by γ -rays from ThC'' . The data agree with the theory of Bethe and Heitler. There appears to be a real difference in the angular distribution of the positrons and electrons, particularly at angles $<15^\circ$, for this region includes 34% of the positrons and only 18% of the electrons. The mean energy difference between the positrons and electrons is 100 ekV and is in agreement with theory. This difference increases with increasing atomic number. The average angle between the pairs is 48° , which is considerably higher than that reported by previous workers. [See following Abstract.] F. C. C.

3649. Nuclear Impulse in Pair Creation. L. V. Grošev and I. M. Frank. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 4. pp. 239-242, 1938. *In English.*—Calculation is made of the impulse transmitted to the nucleus during the creation of pairs by γ -rays. For the principal γ -ray line from ThC", namely $h\nu = 5.2 mc^2$, the maximum impulse transmitted to the nucleus is $0.4 mc$. In most cases the departure from coplanarity between the plane of the positron and electron tracks and the direction of the incident photon is not greater than 12° . [See preceding Abstract.] F. C. C.

3650. γ -Radiation from Actinium. E. Kara-Michailova. *Cambridge Phil. Soc., Proc.* 34. pp. 429-434, July, 1938.—Owing to uncertainty in the values of the intensity of γ -radiation emitted by active Ac deposits, this investigation was made in an attempt to obtain a more direct estimate of the total energy emitted as γ -radiation by Ac(B+C). An ionisation chamber filled with N_2 at 30 atm. was used since the γ -radiation was very weak. The results of the experiment are entirely inconclusive and do not permit of a decision for or against the proposed level scheme for the AcC nucleus. G. O. B.

3651. γ -Ray Ionisation in Gases at High Pressures. J. Clay and M. Kwieser. *Physica*, 5. pp. 725-736, Aug., 1938. *In English.*—The ionisation was measured in Kr, A and N_2 at pressures up to 140 atm. and fields up to 6000 V/cm. Two different vessels were used. For each gas there is a range of pressures for which an excess of ionisation above the normal value has been found. The influence of a small amount of O_2 in A and N_2 has been measured. At high ionisation and lower field the amount of volume-recombination could be measured by using a new method. The influence of pressure could be tested. The relation of ionisation by γ -rays for different gases was measured, but it was found not to be the same for rays of different energy. AUTHORS.

3652. Dependence of Ionisation by Penetrating- and γ -Radiation upon Pressure. J. Clay. *Zeits. f. Physik*, 109. 7-8. pp. 477-484, 1938.—Experiments were carried out to test the validity of the extrapolation of Jaffé's columnar ionisation formula in the linear form given by Zanstra, for a number of gases up to a pressure of 150 atm. with penetrating radiation and γ -radiation as ionising agents. The two radiations differ in their dependence of the saturation gradient on the field strength and the gas pressure, nor is the critical pressure the same for both. Below the critical pressure the saturation current is proportional to the pressure but above it, it is given by an expression $I = Ap + B + Cp$ where A, B and C depend on the gas and the materials of the walls, the values being different for the two radiations. For photons, C is equal to zero. With γ -radiation, the ionisation is approximately proportional to Z^2 for different gases, whereas for penetrating radiation it is approximately proportional to the density. F. C. C.

***3653. New Valve Counting Circuits.** H. J. Reich. *Rev. Sci. Instruments*, 9. pp. 222-223, July, 1938.—Various new valve trigger circuits are described. They have been operated successfully at frequencies above 15 kc./sec. but the upper frequency limit has not yet been determined. F. C. C.

***3654. Improvement in Coincidence-Counting Circuit.** S. Gorodetzky. *Comptes Rendus*, 207. pp. 57-58, July 4, 1938.—It is pointed out that in coincidence-counting circuits of the Rossi-type, the power of discriminating between true and false coincidences, and also

the resolving power, may be reduced if the impulse passed on by the group of valves to which the counters are individually coupled is large. It is shown that if the impulse, instead of being applied directly to the grid of the succeeding valve, is applied to a potentiometer, from which a suitable fraction is tapped off and applied to the grid, then this state of affairs is largely remedied. [See Abstract 2405 (1938).] D. H. F.

***3655. Upper Limit of Ion Energy Obtainable by Means of the Cyclotron.** J. Khurgin. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 4. pp. 237-238, 1938. *In English*.—It is shown theoretically that (1) the decrease of the magnetic field towards the edge of the apparatus and (2) the relativistic increase of mass with velocity, result in an increased period of revolution of the ions in a cyclotron and the consequent destruction of resonance. The maximum energy obtainable for an accelerating voltage of 0.1 eMV is shown to be 21.9 eMV for protons, 31.0 eMV for deuterons and 62 eMV for α -particles for the most favourable case of a uniform magnetic field. Any inhomogeneity in the magnetic field results in a lowering of the maximum energy by an amount which may be 50%. The values obtained are about twice those given recently by Bethe and Rose and the divergence in the results is discussed.

F. C. C.

See also Abstracts 3434, 3559.

RADIATION.

ABSORPTION.

3656. Absorption Coefficients of Ozone in the Region of the Chappuis Bands. A. Vassy. *Comptes Rendus*, 206. pp. 1638-1639, May 30, 1938.—Data for the absorption coefficients of O_3 at 16 different thicknesses (from 7 to 26 cm.) and at a mean temperature of 18° are recorded. [See Abstract 3041 (1937).] W. R. A.

COLORIMETRY.

***3657. Objective Measurement of Colour.** J. W. Perry. *Journ. Sci. Instruments*, 15. pp. 270-277, Aug., 1938.—The general principles of direct photoelectric colour measurement and their application to the "Blancometers" are considered. Two categories of such colour measurement are distinguished. A description is given of the "Blancometers" and the method of measurement employed in their application to the measurement of colour differences. AUTHOR.

EMISSION.

3658. Interaction between a Photon and an Electron, in accordance with Wave Mechanics. J. Géhéniau. *Comptes Rendus*, 206. pp. 1711-1713, June 8, 1938.—The elementary phenomena concerned in the interaction between a photon and an electron are discussed in terms of wave mechanics, employing a system of trihedral coordinates, without appeal to quantum field theory. J. S. G. T.

3659. Equation of Propagation of a Photon in Non-Euclidean Space. M. A. Tonnelat-Baudot. *Comptes Rendus*, 206. pp. 1714-1715, June 8, 1938.—The equations of propagation of a photon in a twisted non-Euclidean space of zero curvature are derived by the application of Dirac's general matrix theory. The identity relations and the electromagnetic equations appear in modified form, the former containing a second member and the latter supplementary terms. J. S. G. T.

3660. Classical Theory of Radiating Electrons. P. A. M. Dirac. *Roy. Soc., Proc.* 167A. pp. 148-169, Aug. 5, 1938.—The object of the paper is to set up in the classical theory a self-consistent scheme of equations which may be used to calculate all the results that can be obtained from experiment about the interaction of electrons and radiation. The electron is treated as a point charge and the difficulties of the infinite Coulomb energy are avoided by a procedure of direct omission or subtraction of unwanted terms, somewhat similar to what has been used in the theory of the positron. The equations obtained are of the same form as those already in current use, but in their physical interpretation the finite size of the electron reappears in a new sense, the interior of the electron being a region of space through which signals can be transmitted faster than light. AUTHOR.

3661. Large Cosmic-Ray Bursts and Cascade Theory. C. G. Montgomery and D. D. Montgomery. *Phys. Rev.* 53. pp. 955-959, June 15, 1938.—On the basis of the cascade theory of showers, the energy spectrum of the electrons and photons incident on a thin layer of material is calculated from the observed frequency distribution in size of bursts. The energy spectrum obtained is in agreement with that calculated by Heitler to explain the variation of cosmic-ray intensity with altitude. An estimate of the number of electrons necessary to produce the observed frequency of bursts is in good agreement with cloud-chamber observations. Calculations of the number and frequency distribution of showers from large thicknesses of material show considerable discrepancies from observed results, but this is probably due to the effect of the penetrating component. It is concluded that the cascade theory is entirely adequate to account for all the observed bursts; the Heisenberg single-process mechanism of shower production need not be invoked. D. H. F.

3662. Solar Diurnal Variation of Cosmic-Ray Intensity as a Function of Latitude. J. L. Thompson. *Phys. Rev.* 54. pp. 93-96, July 15, 1938.—The cosmic-ray data collected by A. H. Compton and R. N. Turner on the Pacific Ocean from March 17, 1936 to Jan. 18, 1937, have been analysed for a possible change with latitude of the solar diurnal intensity variation. A new geomagnetic latitude curve is shown based on these data and designed to remove periodic fluctuations due to unequal distribution of data with time. A method of combining data from a wide latitude range is developed and applied. Solar diurnal variation curves for latitudes ranging from 54.7° N. to 40° S. (geomagnetic) show no substantial variation in either amplitude or phase. The mean amplitude of the first harmonic of a Fourier analysis is found to be 0.24% with time of maximum being 14 hr. 06 min. AUTHOR.

3663. Sidereal Time Variation of Cosmic Radiation. H. Alfvén. *Phys. Rev.* 54. pp. 97-98, July 15, 1938.—If it is supposed that the positive and negative cosmic-ray particles are not equal in number, the resulting space charge will be neutralised by slowly moving ions which should follow the motion of the stars. If the cosmic-ray particles are not

isotropic relative to the stellar system, as for example if they do not share the motion of galactic rotation, the relative motion of the slow ions and the cosmic-ray particles of opposite sign produces in effect an electric current. Calculation shows that the resulting magnetic field may become as great as 10^{-1} gauss if there is a considerable difference between the number of positive and negative particles. It is shown that the anisotropy corresponding to even a small sidereal time variation of the cosmic radiation would imply such great magnetic fields as to bend the paths of cosmic-ray particles in curves of radii small compared with interstellar distances. Therefore, the high degree of isotropy of the cosmic radiation is a necessary consequence of the fact that it consists mainly of charged particles and does not tell us anything about the place of origin of the radiation.

AUTHOR.

3664. Cosmic-Ray Intensity at High Elevations in Northern Latitudes. T. H. Johnson. *Phys. Rev.* 54. pp. 151-152, Aug. 1, 1938.—Balloon flights with vertical coincidence counters for cosmic-ray measurements have been made at geomagnetic latitudes 56° N. and 69° N. Within the accuracy of the measurements there is no further increase of intensity above 56° N. at atmospheric depths greater than 2 m. of water.

AUTHOR.

3665. General Theory of the Earth's Shadow Effect of Cosmic Radiation. E. J. Schremp. *Phys. Rev.* 54. pp. 153-157, Aug. 1, 1938.—An inquiry is made into the fundamental mode of origin of the allowed cone of cosmic radiation introduced by Lemaître and Vallarta [see Abstract 4682 (1936)]. Two kinds of allowed cone are distinguished. One of these, that discussed by Lemaître and Vallarta, postulates the presence of an impenetrable earth; for it all forbidden directions are due to the earth's shadow effect. The second type of allowed cone, applicable in the first approximation to such problems as that of the sun's magnetic field, does not postulate the presence of an impenetrable earth; for it all forbidden directions are associated with bounded charged particle orbits. The general topological features of each of these kinds of allowed cone, and their relationship to one another, are described. [See following Abstract.]

AUTHOR.

3666. Simple Shadow Cone of Cosmic Radiation. E. J. Schremp. *Phys. Rev.* 54. pp. 158-162, Aug. 1, 1938.—The present paper is a brief summary of the results obtained from a study, by means of Bush's differential analyser, of those trajectories of a charged particle in the field of a magnetic dipole which determine the simple shadow cone for all latitudes and energies. [See preceding Abstract.]

AUTHOR.

See also Abstracts 3594, 3645, 3652, 3654, 3731, 3742.

FLUORESCENCE AND PHOSPHORESCENCE.

LUMINESCENCE AND AFTERGLOW.

3667. Fluorescence of Chlorins. A. Stern. *Zeits. f. phys. Chem.* 182. *Abt. A.* 3. pp. 186-192, 1938.—The fluorescence spectrum of meso-pyrrochlorin is the same in type as that of pyrroporphyrin. Both spectra have five bands but that of meso-pyrrochlorin is displaced towards the red. The similarity between the fluorescence spectra of the poprhyrins and the corresponding chlorins indicates that the chlorins and chlorophyll derivatives in general have the same inner ring system as the porphyrins. This is supported by the relationship which has also been observed between absorption and fluorescence.

A. J. M.

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3668. ZnS Phosphors. F. Seitz. *J. Chem. Phys.* 6. pp. 454-461, Aug., 1938.—The properties of pure and Cu-activated ZnS phosphors are described, and an attempt is made to interpret these properties following the plan of a previous paper on alkali halide phosphors activated by Tl. It is pointed out, as has been done by previous workers, that the combination of photoconductivity and bimolecular decay law of phosphorescence implies that an ionisation process accompanies the excitation of ZnS phosphors. By applying the ideas of the quantum theory of solids, it is shown that this ionisation process does not correspond to the freeing of an electron from the Zn^{++} or S^- ions of the lattice. It is concluded that the pure ZnS phosphor probably contains neutral interstitial Zn atoms, and that these are responsible for the luminescence and photoconductivity. By analogous reasoning, it is concluded that the Cu-activated phosphor contains interstitial Cu atoms. The relative stability of interstitial copper atoms and substitutional copper ions is discussed in terms of the Schottky-Wagner theory of deviations from stoichiometrical proportions. It is concluded that the interstitial Cu atoms probably are in a metastable condition. AUTHOR.

3669. Thermo-Luminescence of Quartz Exposed to X-Rays. T. Futagami. *Phys. Math. Soc. Japan, Proc.* 20. pp. 458-466, June, 1938.—Quartz, exposed to X-rays, obtains a smoky colour, and if the crystal is heated, the colour will fade away, emitting thereby a blue thermo-luminescence. The absorption spectrum of coloured quartz was examined, and it was found that it extends all over the regions of infra-red, visible and u.v. spectra, and that there exist two flat maxima at $390\text{ m}\mu$ and $302\text{ m}\mu$. The intensity variations of the thermo-luminescence with respect to time and temperature were investigated by a rotating film apparatus. The spectrum of the thermo-luminescence was obtained by a quartz spectrograph, and it was found to be a continuous one ranging from $610\text{ m}\mu$ to $385\text{ m}\mu$ with a maximum at $469\text{ m}\mu$. The intensity distribution of the spectrum was also determined. AUTHOR.

3670. Kathodoluminescence of Luminescent Al_2O_3 . E. Iwase. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers No.* 800. pp. 761-774, July, 1938. *In English.*—On several specimens of natural Al_2O_3 minerals from Japan as well as from foreign countries, the luminescence under excitation by kathode rays was examined. Spectrographical studies were made on the kathodoluminescence exhibited by specimens of Japanese corundum. As the specimens of ruby from North Carolina exceed any other in the brightness of the luminescence, their emissions, excited by both kathode and u.v. rays, and their light-transmission were investigated in some detail. Some of the emission bands observed have not yet been recorded by any former investigators. For the luminiferous synthetic materials, $\text{Al}_2\text{O}_3\text{-Bi}$, $\text{Al}_2\text{O}_3\text{-U}$, $\text{Al}_2\text{O}_3\text{-Sm}$, $\text{Al}_2\text{O}_3\text{-Mn}$, and $\text{Al}_2\text{O}_3\text{-Cr}$, the influence of the concentration of activators and the calcination temperature upon the colour of kathodoluminescence was examined. AUTHOR.

3671. Formation and Excitation of Molecular Ions in Active Nitrogen. U. Stille. *Zeits. f. Physik*, 109. 7-8. pp. 491-502, 1938.—A criticism of the excitation mechanism proposed by Kaplan for the high pressure excitation of the negative bands in the after-glow. A collision between a molecule in the G-K level and a metastable $\text{A}^3\Sigma_u^+$ molecule does not provide sufficient energy whilst a collision between two molecules in G-K levels provides 24.44 eV , which is considerably more than the maximum of 19.39 required for the negative bands. Moreover, according

to Kaplan's mechanism, a molecule in the G-K level would have to survive up to 10000 collisions. [See Abstract 5300 (1937).] G. C. E.

3672. Preparation and Properties of Auroral Afterglows. J. Kaplan. *Phys. Rev.* 54. pp. 176-178, Aug. 1, 1938.—The preparation of auroral afterglows in pure nitrogen is discussed in detail. A nomenclature is introduced for the five stages which are met most frequently in the preparation of these glows. In the normal order in which they occur they are the O_3 , NO, CN, Lewis-Rayleigh, and finally the auroral stage. Two plates, one showing the spectrum of the discharge in pure nitrogen, which is responsible for the production of the auroral glow, and one which shows the spectra of the NO, CN and auroral stages, are reproduced. AUTHOR.

See also Abstracts 3695.

INTERFERENCE, DIFFRACTION AND SCATTERING.

3673. Theory of Intensity Anomalies in Diffraction. U. Fano. *Ann. d. Physik*, 32. 5. pp. 393-443, July, 1938.—While the intensity of a diffracted wave is in general a slowly variable function of the diffraction parameter, in many researches with optical and material waves anomalous intensity effects have been observed. Such anomalies, together with a series of allied anomalies from different realms of physics, are here discussed as far as possible from a common viewpoint. A formal mathematical development is in many cases far from simple and the final formulæ can only with difficulty be compared with experimental results, since the experimental conditions are not sharply enough defined to furnish accurately the initial data included in the theory. On this account the aim of the paper is directed to elucidating more the physical aspect and the inner nature of the phenomena in question, than developing mathematical theory. The various sections of the paper deal with (1) Wood's optical anomalies (historical). (2) Development of the Rayleigh-Voigt dynamic theory of the grating. (3) Wood's optical anomalies (discussion). (4) The anomalies of reflection and diffraction of molecular rays. (5) The connection between some diffraction anomalies for X-rays and electron rays (Kossel and Kikuchi lines and particularly Kikuchi envelopes). A. W.

3674. Concept of Degree of Coherence and its Application to Optical Problems. F. Zernike. *Physica*, 5. pp. 785-795, Aug., 1938. *In English*.—The maximum visibility of the interferences obtainable from two points in a wave field is defined as their degree of coherence γ . By a simple statistical method general formulæ are found for deducing γ from illumination data. For any extended light-source γ is found equal to the amplitude in a certain diffraction image. It does not change by the use of a condensing lens, but depends only on the aperture of the illuminating cone. These properties are applied to the microscopic observation of objects in transmitted light. AUTHOR.

3675. Molecular Diffusion of Light by Liquids. Variation of Diffused Intensity with Wave Length. A. Rousset and R. Garnier. *Comptes Rendus*, 207. pp. 142-145, July 11, 1938.—Comparison of the variation of the intensity of the light diffused by benzene with that of CCl_4 , acetic acid, and ethyl alcohol, by the method of photographic photometry, shows that, in the spectral range 3650 to 5460 Å, benzene follows the Vessot-King rule. The ratio of the existing absolute values of the intensity of light diffused by ether and by benzene agrees with that calcu-

lated from the Vessot-King rule and also shows that benzene obeys the rule. W. R. A.

See also Abstracts 3444, 3445, 3622.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

3676. Photolysis of H_2S . G. S. Forbes, J. E. Cline and B. C. Bradshaw. *Am. Chem. Soc., J.* 60. pp. 1431-1436, June, 1938.—Highly purified H_2S and HBr were photolysed successively in a rotating quartz cell. Assuming that one quantum produces one molecule of H_2 from HBr at 400 mm. the quantum yield of H_2S is 1.02 ± 0.05 molecules of H_2 per quantum. This quantum yield is independent of pressure over the range 8-1400 mm., and also of light flux (for 208 m μ). The mechanism of the photolysis is discussed. A. J. M.

3677. Action of U.V. Rays on Mercury Fulminate. A. Borocco. *Comptes Rendus*, 207. pp. 166-168, July 11, 1938.—The change of colour of mercury fulminate on exposure to u.v. radiation depends on the duration of exposure and on the intensity of the radiation. Measurements of the density and X-ray spectrum, and microscopical examination, show that the structure of the fulminate has not been affected. Exposure of mercury fulminate *in vacuo*, however, indicates partial decomposition to Hg , CO_2 and N_2 . The total effect of exposure to u.v. radiation is thus analogous to that produced by heating. W. R. A.

3678. Photochemical Processes in Crystals. R. Hilsch and R. W. Pohl. *Faraday Soc., Trans.* 34. pp. 883-888; *Disc.*, 888-892, Aug., 1938.—The authors deal with photochemical processes in solid solutions of the alkali halides and hydrides and the application of the electrical method of measurement, in which former difficulties have been overcome. In the *Discussion*: N. F. Mott attempts a mathematical description of the suggested process by which colour centres are produced in KBr containing KH or KD . W. F. Berg contributes a paper on the "Nature of the Latent Image Particles and of the Coloration in Silver Halide Crystals," in which, from the apparent analogy between the latent image and the particles producing the red coloration in single crystals of silver halides under the action of blue light, it is concluded that these particles consist of a few Ag atoms only, and that the coloration is due to a genuine absorption process and not to scattering of light. Berg opines that the absorption process is probably a photoelectric effect by which electrons are emitted from the Ag into the crystal. F. Weigert states that the best-supported assumption for the primary effect of light is that an electron is ejected from a Ag atom and caught suitably in its neighbourhood (*e.g.*, by a Ag ion) and in all directions round the Ag particle where it is in contact with the halide. In using polarised light the particle is peeled off preferentially at those faces which are parallel to the plane of polarisation, and an anisotropic particle is produced. If this hypothesis is proved to be correct the scattering and the absorption of red light are quite different phenomena. H. H. Ho.

3679. Primary Processes in Photodecomposition. M. Burton and G. K. Rollefson. *J. Chem. Phys.* 6. pp. 416-423, Aug., 1938.—When energy is absorbed by a molecule at a particular bond by a process of transition to a repulsive energy level or a sufficiency high point on an attractive level, rupture always results within one vibration period. All other photodecomposition processes are properly included under the title of predissociation. Thus, rupture may also result at the locus of absorption

as the result of either spontaneous or induced adiabatic transition from an attractive to a repulsive or "weakly attractive" level. These are the only mechanisms of predissociation in diatomic molecules. In polyatomic molecules, spontaneous or induced shifts of energy or rearrangements of groups, resulting in decomposition, may also occur. Illustrations of the various processes suggested are cited from the photochemistry of S, I, O₃ and the aldehydes. In the case of formaldehyde it has been possible to distinguish potential hypersurfaces and to indicate two different types of predissociation: one in a single hypersurface and the other a spontaneous transition between two hypersurfaces. The method used is extended to other aldehydes. Suggestions are made as to the interpretation of the photochemistry of several other substances and as to several problems which require solution. AUTHORS.

3680. Adsorption Theory of Photographic Development. A. J. Rabinovitch. *Faraday Soc., Trans.* 34. pp. 920-926; *Disc.*, 936-940, Aug., 1938.—Discusses previously published results of investigations on the physico-chemical aspect of the process of photographic development. Two main lines are followed, one tending to give a quantitative description of this process as well as stating the laws governing it, the other attempting to explain the underlying mechanism. R. C. F.

3681. Gelatin for Photographic Use. A. P. H. Trivelli and W. F. Smith. *Zeits. f. wiss. Phot.* 37. pp. 123-129, June, 1938.—Critically examines the Russian proposal for standardising gelatin which is to be used for photographic purposes. It is concluded from experimental results given, that the standardisation suggested by the results of Makarov, Chibisov and Mikhailova is not sufficiently justified for practical use. R. C. F.

3682. Contrast and Number of Grains in Photographic Emulsions. A. P. H. Trivelli and W. F. Smith. *Zeits. f. wiss. Phot.* 37. pp. 140-146, June, 1938.—Shows that the direct proportionality between contrast and the number of grains/cc., suggested by Makarov, can only be approximately true within narrow limits. With a number of emulsions the contrast is proportional to the logarithm of the number of grains. If the least dense region be excluded it is found that an even better relationship is obtained by considering the contrast and the square root of the number of grains. R. C. F.

3683. Spectral Sensitivity of Photographic Layers. J. Eggert and M. Biltz. *Faraday Soc., Trans.* 34. pp. 892-901; *Disc.*, 908-912, Aug., 1938.—The sensitivity of photographic AgBr layers has been measured as a function of the wave-length; the state of ripening, the AgI content, and dye sensitisation have been varied. The relations between AgBr and dye content, absorbed light quanta and developed density have been established quantitatively for a layer sensitised optimally for the green. The ideas which appear most probable at present regarding the mechanism of the photographic process are set forth on the basis of the present and of earlier experimental results: (a) The sensitivity of the AgBr is ascribed to *Störstellen* in the crystal lattice, the energy supplied to these zones leading to their photolayers and to the production of new *Störstellen* in the previously undisturbed AgBr crystal. (b) In the region of longer waves, from about 500 m.μ. onwards, the magnitude of the sensitivity of unsensitised layers is essentially determined by the *Störstellen* only. The AgBr acts as an energy carrier in the region of its strong intrinsic absorption from about 500 m.μ. towards shorter wave-lengths.

(c) The substances, added to the photographic layers to increase the sensitivity particularly in the region of the longer waves, such as Ag-I and dye sensitisers especially, are also to be considered as energy carriers which give up the absorbed light to the *Störstellen*. [See following Abstract.] H. H. Ho.

3684. Photosensitisation by Solids. C. F. Goodeve and J. A. Kitchener. *Faraday Soc., Trans.* 34. pp. 902-908; *Disc.*, 908-912, *Aug.*, 1938.—The essential feature in a photosensitised as distinct from a direct photo-process is the transfer of the energy from the spot where it is absorbed to one where an emission of fluorescent radiation or a reaction, can take place. The authors now discuss this process in solids under three headings: (1) the light absorbing species; (2) the mechanism for the transference of the absorbed energy; (3) the potentially reactive (or fluorescent) centre. Sections are then devoted to fluorescent phosphors, photosensitisation by pigments, the photographic process (which may involve both direct and sensitised photo-reactions), and the degradation of the exciton to heat. In the *Discussion*: W. E. Garner dealt with the investigation of the nuclei formed by the action of light on crystals in which he had found there are a limited number of places at which such nuclei appear, and also that the thermal nuclei and those started by light are very largely independent of one another; J. Weiss considered the similar behaviour of ions in solution to ions in ionic crystals; J. Boulton suggested further definite experiments on the bleaching of sky blue FF on TiO_2 ; and T. H. Morton criticised the exciton hypothesis. Morton's criticism is comprehensively dealt with by the authors in their reply. [See preceding Abstract.] H. H. Ho.

3685. New Time Phenomenon in Photographic Emulsions. F. Weigert. *Faraday Soc., Trans.* 34. pp. 927-930; *Disc.*, 936-940, *Aug.*, 1938.—The photodichroism produced on an oblique film of AgCl gelatin by the combined action of beams of natural light of blue and red colour when plotted against the spectrum was the more positive as the length of the dark time interval elapsing between a blue and red exposure was increased. A dark interval following a red exposure had no perceptible influence. It is suggested that this is due to the production, by the action of the blue light, of a sensitiser for red which slowly loses its activity. AUTHOR.

3686. Photographic Sensitivity. Lüppo-Cramer. *Faraday Soc., Trans.* 34. pp. 930-935; *Disc.*, 936-940, *Aug.*, 1938.—The statements in the literature that pure dry silver halides are not photographically sensitive at all (that is, without development) are mutually contradictory and should therefore be tested. The main part of the sensitivity of ordinary photographic plates in any case arises from the germs. With layers quite free from binding material the sensitivity decreases with increasing grain size, since the smaller grain is more easily accessible to purely chemical reduction by the developer. These relationships are reversed with gelatin-AgBr since here the protective action of the colloid is decisive and this is more effective with small grains than with larger ones. The optically measurable light-absorption constitutes no measure for the light-sensitivity since only the *chemical* absorption is decisive for the utilisation of the radiant energy and the former is for its part greatly influenced by the internal reversal phenomena. Even the penetrating energy of X-rays does not result in a uniform distribution of the latent image over the whole grain, so that even the X-ray image is for the most

part concentrated on the grain surfaces, as is manifest from the behaviour towards desensitising dyes and oxidising agents. Other reversal phenomena and their significance for photographic sensitivity are discussed. AUTHOR.

3687. Influence of Partial Grain Solution on Developable Blackening. G. Ungar. *Zeits. f. wiss. Phot.* 37. pp. 130-139, June, 1938.—Discusses the previously published work of Kempf on the topography of the latent image [see Abstract 5313 (1937)] and shows that his conclusions on the distribution of the latent image are incorrect. A new explanation for the shape of the curve connecting grain size with blackening, and obtained with physical development, is given, the shape of the curves obtained with chemical development being also discussed. Finally, the relationship between mean grain radius and the number of grains is mathematically developed in an appendix. R. C. F.

3688. Latent-Image Formation, Reciprocity Law Failure at Low Temperatures. J. H. Webb and C. H. Evans. *Kodak Research Lab., Comm. No. 674. J.O.S.A.* 28. pp. 249-263, July, 1938. *Sci. et Ind. Phot.* 9. pp. 257-266, Sept., 1938.—The results are given of experiments to test the theory of latent-image formation proposed by Gurney and Mott, who introduced the concept of electrolytic transportation of Ag^+ ions to account for the nucleation of latent image Ag about the sensitivity specks pre-existent on the surface of the grains. The Ag^+ ions diffuse to the specks under the attraction of electrons trapped there during the exposure to light. The first experiment consisted of a series of intermittent exposures made at liquid air temperature with warm-up periods between flashes, and the results indicate that something vital to the photographic process takes place during the warm-up period between exposures. The second experiment consisted of a series of Herschel exposures made under a variety of temperature conditions. The results obtained are radically different under the different conditions. It is found that the low-intensity reciprocity law failure has disappeared at -78°C . and that the high intensity failure has practically disappeared at -186°C . All of the results are shown to have ready interpretation on the Gurney-Mott picture of latent-image formation. A. H.

3689. Mechanism of Photographic Reversal. G. W. W. Stevens and R. G. W. Norrish. *Phot. J.* 78. pp. 513-529; *Disc.*, 529-533, Aug., 1938.—The Sabattier effect is investigated experimentally and it is found that the reversal is concerned only with grains not affected by the first exposure and that it is produced with very short first developments. The log. desensitisation is found to be directly proportional to the first developed density only if the latter be varied by changing the first exposure; metallic silver (because of its deposition on the unexposed grains in the vicinity of the latent image during the first development) is thought to be the probable cause of the desensitisation. This conception is used to predict new facts about the Albert effect. The desensitisation is probably concerned with the function of the ripening nuclei. A. H.

3690. Physical Development of the Latent Image. W. Reinders and M. C. F. Beukers. *Faraday Soc., Trans.* 34. pp. 912-919; *Disc.*, 936-940, Aug., 1938.—On account of the good results obtained by the authors with the physical development of the latent image according to Odell, investigations with respect to the physical development were undertaken. A strong Eberhard-effect occurs, which causes increase of contrast in lined figures, since the density of the lines in the negative

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is more intense than that of an equally strongly exposed large area. At equal line density the broadening of the lines, due to diffuse dispersion in the emulsion, is less than the chemical development. In the usual neutral developers for physical development which contain Na_2SO_3 and $\text{Na}_2\text{S}_2\text{O}_3$, the difference ΔE between the Ag potential and the reduction potential is 100 to 170 mV, *viz.*, considerably lower than in the solutions for rapid chemical development, and somewhat lower than in the slow-acting fine grain developers. In the solutions where $\Delta E = 100$ mV, the spontaneous formation of Ag is considerably less than in the solutions with higher ΔE . The Ag potential in the solutions may be varied within wide limits by changing the relation $\text{AgNO}_3 : \text{Na}_2\text{S}_2\text{O}_3$. AUTHORS.

3691. Photography and Kinematography of the Emission of the Scent of Flowers. H. Devaux. *Soc. Franç. Phot. et Ciné., Bull.* 25. pp. 109–111, July, 1938.—Briefly describes two methods whereby it has been possible to photograph the emission of scent from various flower petals. In the first method the flower petal is held very close to a Hg surface dusted over with talc powder, the powder moving progressively outwards, due to the flower scent, until a circle of 10 to 15 cm. dia. is obtained. The other method, which is more simple and sensitive, consists of holding the petal within 2 or 3 mm. of a clean Hg surface, and then, after 5 mins., covering the mercury surface with a thin film of moisture, when a stain appears due to the scent fixed on the Hg. R. C. F.

See also Abstracts 3742.

PHOTOMETRY.

3692. Problems in Heterochromatic Photometry. H. König. *Helv. Phys. Acta*, 11. 5. pp. 432–460, 1938. *In German.*—The problems treated by the author are (i) the determination of the luminosity (visibility) curve by means of a limited number of observations using an approximate curve as basis and the measurement of a number of colour filters, (ii) the establishment of a combination blue filter to change one black-body temperature to another, (iii) the approximation of the spectral transmission curve of a combination filter to the luminosity (visibility) curve of the eye. The problems are attacked by the method of successive approximations. J. W. T. W.

3693. Photometry of Coloured Light Sources. W. E. Forsythe, B. T. Barnes and A. L. Shrider. *J.O.S.A.* 28. pp. 241–248, July, 1938.—Describes an investigation of the variations between different observers when measuring coloured light sources, such as Hg and Na discharge lamps and various fluorescent lamps, using different types of photometer heads. Colour filters were used to obtain an approximate match in the photometer field of a Lummer-Brodhun head with (a) a large field ($8-10^\circ$) and (b) a small field (2°). Then the results obtained with an Ives-Brady flicker photometer were compared with those given by direct comparison. Full details of the screens used and of the Y/B ratios of the observers are given. Finally the relative luminosities of the yellow and green Hg lines were found for 18 observers using the flicker photometer, and the average ratio found, 1.360, agreed well with that calculated from the I.C.I. visibility data. J. W. T. W.

3694. Spectral Luminosity Curve of the Eye. A. Dresler. *Zeits. f. techn. Physik*, 19. 7. pp. 206–212, 1938.—The investigations which culminated in the adoption in 1924 of a standard spectral luminosity curve

of the eye are reviewed. The results of certain later workers are then examined which seem to show (a) that when unexceptionable light-adaptation is secured the luminosity curve obtained by the flicker or small-steps direct comparison methods is shifted slightly towards the red with respect to the standard curve, and (b) that in direct heterochromatic comparisons with unrestricted colour differences the additive law breaks down. The need for further determinations of the luminosity curve by different workers having regard to these effects is stressed.

W. S. S.

See also Abstract 3746.

POLARISATION.

3695. Fundamental Polarisation and Temperature. A. Jabłoński. *Acta Physica Polonica*, 7. 1. pp. 15–23, 1938. *In German*.—Polarisation measurements have been made of the fluorescent light of certain dye-adsorbates and of a strong solution of fluorescein in alcohol. The degree of polarisation of the alcoholic fluorescein solution at -110° to -148° is the same as for a glycerol solution at room-temperature. The dye-adsorbates also give values independent of temperature. It is concluded, therefore, that the degree of polarisation is not dependent on temperature in contradiction to Cahen's results. Differences in the degree of polarisation with temperature were observed when the alcoholic solution of fluorescein was examined at -170° C. but this is not significant since all solutions show variable values with time at constant temperature.

W. R. A.

3696. Optical Properties of Stratified Cholesteric Substances. J. P. Mathieu. *Comptes Rendus*, 206. pp. 1890–1891, June 20, 1938.—The changes in wave-length, λ , and the polarisation caused by transmission through, and diffusion by films of various esters of cholesterol 1–50 μ thick, were determined as functions of λ , in detail in the cases of the propionate and cinnamate, and sufficiently to show the phenomena to be similar in those of the butyrate, pelargonate, caprate and benzoate. Light of a given λ diffused normally to the film forms a band of width 20 μ , and is circularly polarised. Transmitted light is usually polarised elliptically, but for a certain thickness circularly (10 μ and 20 μ for the cinnamate and propionate respectively). The rotatory power of these esters varies from 500° to $10,000^\circ$ mm. according to λ and the ester. A magnetic field of 15,000 gauss has no effect.

C. A. S.

See also Abstracts 3470, 3685, 3699.

REFLECTION, REFRACTION AND DISPERSION.

3697. Reflection Coefficient of Mercury. R. C. Mason. *J. of Applied Physics*, 9. pp. 535–539, Aug., 1938.—Two new methods for measuring the reflection coefficient of Hg atoms from a Hg surface are described. In the first, a micromanometer gives both the change in pressure on the surface, and the subsequent rate of evaporation, when a Hg pool is exposed to an opposing liquid-air cooled condensing target. From these, reflection coefficients from 0.93 to over 0.99 are obtained. In the second, from measurement of the vapour density between evaporating and condensing surfaces by an ionisation gauge, the reflection coefficient can be calculated. With careful purification of the mercury, quite small reflection coefficients result, a mean of 0.2, and a minimum of

0.07 being found. Exposure of the Hg surface to the atmosphere for half an hour brings the reflection up to 0.8, while after 10 days' exposure the reflection coefficient becomes 0.92. AUTHOR.

3698. Adjustments and Measurements by Means of Images Obtained by Multiple Reflections. A. Guillet. *Comptes Rendus*, 207. pp. 61-63, July 4, 1938.—First-order images obtained by double reflection from two mirrors, one spherical and the other plane, are discussed theoretically. W. R. A.

3699. Wave and Geometrical Optics. S. M. Rytov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 4-5. pp. 263-266, 1938. *In French.*—By applying to the equation of a wave the approximation in reference to wave-length of geometrical optics the conservation of light flux is demonstrated and a law for the rotation of the vectors (polarisation) is deduced. H. G. C.

3700. Influence of Strain on Refractive Index of Glass. N. Winter-Klein. *Comptes Rendus*, 206. pp. 1627-1629, May 30, 1938.—The relative magnitudes of the influences of mechanical strain and structural transformation on the values of the refractive index of glass, annealed at different temperatures, have been investigated. W. R. A.

***3701. Relative Refractive Index of Two Liquids by Photography.** H. O. Kneser. *Zeits. f. Instrumentenk.* 58. pp. 276-278, July, 1938.—The author describes an arrangement which measures the ratio of the refractive indices of two liquids photographically. The liquids are contained in two cells of plane glass, one inside the other. The inner cell is tilted against the outer about an axis perpendicular to the optical axis of the system. The light of a small electric bulb enters the two cells, collimated by a lens, and is reflected by a plane mirror which is arranged inside the inner cell. The image is focused by a cylindrical lens on the lens of a spectrograph. The photographs show a curved line whose distance from any line parallel to the edge of the spectrum is measured. The author has derived a formula which relates this distance to the angle of tilt, the focal length of the lens and the ratio of the refractive indices. The method can be used for u.v. and infra-red light as well as for the visible region. L. K.

3702. Refractive Index of Air in the Visible and Photographic Infra-Red. D. Bender. *Phys. Rev.* 54. pp. 179-183, Aug. 1, 1938.—The refractive index of dry CO₂-free air has been measured from 5300 to 11177 Å by means of a Fabry-Perot interferometer with invar separating posts. The following dispersion curve was obtained for standard conditions (λ in microns): $(n_0 - 1) 10^7 = 2885.59 + 15.77/\lambda^2 + 0.421/\lambda^4$. A comparison of the present results with those of other observers shows that this curve is higher by about 10 parts in 10⁷, and that all curves are nearly parallel. This suggests that the discrepancies are due to systematic errors providing, as seems to be the case, that the constitution of air remains sufficiently constant. In the present experiments systematic errors due to phase change at reflection, methods of purification of the air, and bulk modulus of the invar posts were considered. A calculation concerning the oxygen absorption band at 7600 Å indicates that this band has no measurable effect on the dispersion of air. AUTHOR.

See also Abstracts 3468, 3572, 3718.

SPECTROSCOPY.

3703. Spectroscopy in Industry. G. R. Harrison. *Frank Inst., J.* 226. pp. 1-17, July, 1938.—This article is devoted to a survey of the
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uses to which spectrum analysis may be put and a detailed examination of the methods employed in certain cases. A. H.

3704. Spectrum of Neutral Iridium, IrI. W. Albertson. *Phys. Rev.* 54. pp. 183-184, Aug. 1, 1938.—A new description of the arc spectrum of Ir has been made. The present data include 3100 wavelengths of which 1937 have been accounted for as combinations between 214 energy levels. The normal electron configuration of the Ir I is $5d^7 6s^2$ and the I.P. is approximately 9.2 V. Tables of the most intense lines and of all the energy levels are presented. AUTHOR.

3705. Arc Spectrum of Silicon. C. C. Kiess. Bureau of Standards, J. of Research, 21. pp. 185-205, Aug., 1938.—A new survey has been made of the spectrum emitted by neutral Si atoms. Revised wave-lengths and intensities are given for 400 lines between 1565 Å in the u.v. and 12270 Å in the infra-red. The fine structure of some red and infra-red lines that appear diffuse when emitted by the arcs in air has been resolved by enclosing the light source in an atmosphere of N_2 at reduced pressure. Nearly all the lines have been classified as combinations between known and new singlet and triplet terms required by atomic theory. These terms belong to various series of three or more members each and yield accordant results for the value of the ground state $3p^3 P_0$ of Si I. This value, 65743 cm^{-1} , corresponds to an ionisation potential of 8.11 V. Most of the observed Si lines longer than 3000 Å and many that are not emitted in the arc but are predictable from the terms, correspond to faint Fraunhofer lines heretofore unidentified. [See also Abstract 636 (1934).] AUTHOR.

3706. Arc and Spark Spectra of Tungsten. D. D. Laun. Bureau of Standards, J. of Research, 21. pp. 207-224, Aug., 1938.—The new large quartz-prism spectrograph of the National Bureau of Standards has been used to photograph the arc and spark spectra of tungsten in the u.v. between 3100 and 2100 Å. The wave-length data derived from these observations and also the Zeeman effect observations made with the same instrument, have made it possible to establish the low terms ^6D and ^6S of W II, together with several other metastable terms whose identity is not yet certain. The *raie ultime* of W II is probably the intense line at 2204.49 Å. In W I 89 new levels have been found. The g -values, derived from new Zeeman effects, are given for 37 levels of W I. AUTHOR.

3707. Hydrogen and Deuterium Balmer Series. V. Černiaev. Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R. 19. 4. pp. 243-248, 1938. *In English.*—A comparison is made of the emission of light by the two H isotopes under different conditions with a view to interpreting the nature of the elementary processes in the discharge. A mixture of the isotopes was used and the ratios of the intensities of the series measured under different pressure conditions and with different foreign gases present. The results are discussed at length. A. H.

3708. Hyperfine Structure of Zeeman Components of Resonance Lines of Sodium. D. A. Jackson and H. Kuhn. Roy. Soc., Proc. 167A. pp. 205-216, Aug. 5, 1938.—The hyperfine structure of the Zeeman π components of the two resonance lines of Na was observed by means of the absorption in an atomic beam, the high resolving power instrument being a double etalon with separations of 2 and 8 cm. In strong fields, each Zeeman component was found to possess four hyperfine structure components, proving with certainty that the nuclear spin of Na is $3/2$. The alteration in the spacings of the lines as the field strength was changed

from 3060 to 790 gauss was found to be in excellent agreement with that predicted by quantum mechanics. A direct determination of the hyperfine structures of the terms $3S_{\frac{1}{2}}$ and $3^2P_{\frac{1}{2}}$ was made from the complete resolution of the line 5896. AUTHORS.

3709. Hyperfine Structure of the Forbidden Hg Line 2655.8 Å ($6^3P_0-6^1S_0$). W. Opęchowski. *Zeits. f. Physik*, 109. 7-8. pp. 485-490, 1938.—The hyperfine structure of this line has been measured by Mrozowski [see Abstract 1641 (1938).] This structure shows that the explanation of the appearance of this forbidden line, which rests on the interaction between the nuclear magnetic moment, and the electrons, is correct, and so far this is the only forbidden line for which this explanation has been shown to be correct. In this paper the intensity-ratios of the hyperfine structure components are calculated, and the ratio of their total intensity to that of the resonance-line 2537 Å. The calculated and observed values are in good agreement. A. C. M.

3710. Absorption of the CH_2 Group in the Region of 3μ . J. J. Fox and A. E. Martin. *Roy. Soc., Proc.* 167A. pp. 257-281, Aug. 5, 1938.—The absorption of seven substances containing CH_2 groups has been investigated in the region of 3μ . Besides the aromatic CH bands found about 3.27μ when a benzene ring is present, two or more bands near 3.4μ are attributable to the CH_2 groups. A critical survey of the data available for C_2H_4 enables us to explain the bands observed for CH_2 groups in more complicated molecules. When only one CH_2 group is contained in the molecule, two bands are observed and these are identified as the CH valency vibrations in and out of phase but when the number of CH_2 groups is increased, the coupling between them may increase the number of bands as in dioxane, for example, where four strong bands are observed. A satisfactory approximation to the molecules studied by us is found in a model of the formaldehyde type in which the CH_2 group is attached to a mass of similar magnitude. This model enables us to explain the observed frequencies provided that the CH force constant is 4.52×10^5 dynes/cm., a value considerably lower than 5.02×10^5 for C_2H_4 and 5.88×10^5 for C_2H_2 . The important result is obtained that the mass to which the CH_2 group is attached and the various other force constants involved in compounds of the type investigated have very little effect on the positions of the CH_2 absorption bands in the 3μ region, except in rare cases involving strain of the bonds connecting the CH_2 groups to the rest of the molecule, e.g., fluorene. AUTHORS.

3711. Infra-Red Absorption of Thionyl Chloride. S. Vencov and D. Ștefăneșcu. *Soc. Roumaine de Physique, Bull.* 39. 71. pp. 13-20, 1938. *English Abstract.*—The authors have studied the infra-red absorption bands of $SOCl_2$, between 1 and 9μ . The paper contains a discussion upon the two possible forms of the molecule, the plane and the tetrahedral. These bands are explained by a pyramidal molecular shape. The observed frequencies enable the order of magnitude of the dimensions of this molecule to be determined. AUTHORS.

3712. Influence of Temperature on the Absorption Spectrum of Cadmium Vapour. T. Zamłyński. *Acta Physica Polonica*, 7. 1. pp. 24-33, 1938. *In German.*—The u.v. absorption spectrum of Cd vapour has been investigated. The fluctuation bands (2800 to 2590 Å) have been studied from 580° to 870° and become more diffuse at higher temperatures. The existence of two band groups reported at 3170 and 3070 Å has been confirmed. Two new groups at 3072-2977 Å and at

2840—2800 Å are reported ; the origins of these have not been established.

W. R. A.

3713. Absorption of Gaseous CS₂ in the Schumann Region.

E. Hauptman. *Acta Physica Polonica*, 7. 1. pp. 86–94, 1938. *In German*.—By measuring the absorption bands in the Schumann region the normal vibrations of the CS₂ molecule have been found. They agree well with the determinations from Raman effect, but the frequencies of the optically active vibrations differ slightly from what measurements in the infra-red spectrum had suggested.

R. P.

3714. Absorption Spectra of the Pyrrol Dyestuffs. Part II.

A. Stern and F. Pruckner. *Zeits. f. phys. Chem.* 182. *Abt. A.* 2. pp. 117–126, 1938.—This paper continues previous work [see Abstract 4528 (1937)] and describes the absorption spectra of stercobilin and stercobilin-hydrochloride which have been measured in dioxane and in alcohol for comparison with the spectra of Urobilin IXa and Urobilin IXa-hydrochloride in the same solvents. The spectra while similar nevertheless indicate clearly that the above substances are not identical, and that the influence of solvent upon absorption is not great. The spectra of stercobilin and of its hydrochloride correspond in type to the spectra of pyromethene and its hydrochloride, so that the presence of a pyromethene structure in the former compounds would appear to be established. The spectra also indicate the number of pyromethene chromophores in a bilirubinoid. The absorption spectra of the stercobilin-chloroform compound belongs to the type given by the hydrochlorides of bilirubinoids, and it is concluded that the chloroform is united to the N atom of the pyrrolenin nucleus of the pyromethene-chromophore and thereby produces a similar effect on light absorption to that of salt formation.

H. H. Ho.

3715. Spectra of H₂O in Dioxane and Pyridine. G. S. Landsberg and V. S. Malyshev.

Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R. 18. 8. pp. 549–551, 1938. *In French*.—In previous work on the effect of density decrease on the spectrum of H₂O the decrease has been attained by heating or evaporating. This does not enable the mechanism of the effect to be investigated. Dilution in dioxane surrounds H₂O with molecules of low electrical moment but containing O. Dilution with pyridine introduces molecules of appreciable electric moment and no O. On dilution with dioxane the band (3460 cm⁻¹) moves to higher frequencies and becomes double (the effect produced by heating). Dilution in pyridine leaves the position of the band unchanged but narrows it.

H. G. C.

3716. Absorption Spectra of Praseodymium and Neodymium in D₂O. S. M. Katchenkov.

Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R. 18. 8. pp. 557–558, 1938. *In English*.—A study is made of the absorption spectra of praseodymium and neodymium sulphate solutions in D₂O. The use of D₂O, as compared with H₂O is to shift the absorption bands to the short-wave side and to produce a slight change in the structure of the bands. The effect of change of temperature in the two cases is accounted for as being due to the different physical and chemical properties of heavy and ordinary water. It is also observed that the dissolution of neodymium sulphates in D₂O proceeds more slowly and gives a brighter colour than in H₂O.

A. H.

3717. Absorption Spectra of Chrome Alum Containing D₂O.

H. Böhm. *Ann. d. Physik*, 32. 6. pp. 521–536, July, 1938.—The author has investigated the absorption spectra of chrome alum containing H₂O

and D_2O of crystallisation at different temperatures. The crystals which contain D_2O , show a displacement of the lines of about 60 cm^{-1} as compared with the spectra of the ordinary crystals. For some diffuse lines the shift is so great that it is not possible to assign the lines. The intensity of the continuous spectrum is greatly weakened in the blue for D_2O . The systematic shift of the lines makes it probable that the diffuse lines are caused by a superposition of vibrations on the electronic frequencies.

L. K.

3718. Visible and U.V. Reflection Spectra of Solids. M. Billy and A. Berton. *Comptes Rendus*, 206. pp. 1631-1634, May 30, and pp. 1958-1960, June 27, 1938.—The classification of reflection spectra from polished and rough surfaces is discussed. Reproductions of the spectra of about 30 compounds are given and their characteristics noted. It is claimed that such spectra can be applied successfully to the elucidation of the molecular structure of solids and to problems of polymerisation and dehydration. The experimental arrangement, the influence of particle size, and the method of reflecting the light are discussed. The method can be applied to investigate the molecular constitution of solids which cannot be studied by transmission methods.

W. R. A.

3719. Band Spectra of CaI_2 , SrI_2 and BaI_2 . P. Mesnage. *Comptes Rendus*, 206. pp. 1634-1635, May 30, 1938.—The spectra of CaI_2 (4180-4380 Å), SrI_2 (4250-4480 Å), and BaI_2 (5360-5610 Å) have been analysed; all the bands arise from the diatomic molecules, CaI , SrI , and BaI . The bands of CaI_2 comprise a series of 38 bands and are degraded towards the red. Each band appears as a small doublet. For CaI_2 there is no indication of two systems of bands with a constant frequency separation. SrI_2 , on the other hand, has two systems; one of 26 bands resembling those of CaI_2 and the other of 40 simple bands. Both systems have a lower level in common but different upper levels. BaI_2 has two systems with a separation of 755 cm^{-1} and the sequences are degraded towards the violet.

W. R. A.

3720. Absorption Spectra of Coordination Compounds. Part II. R. Tsuchida. *Chem. Soc. Japan, Bull.* 13. pp. 436-450, June, 1938. *In English*.—Two of the three absorption bands generally met with in the case of a metallic complex have been attributed to electron transitions in an unsaturated transition shell of the central ion [see Abstract 3268 (1938)]. In the present work the origin of the third band is discussed as well as the relation between the absorption and stability of the complex radical.

A. H.

3721. Absorption Spectra and Configuration of Complex Salts. Part II. H. Sueda. *Chem. Soc. Japan, Bull.* 13. pp. 450-452, June, 1938.—*cis*- $[Co(NH_3)_3(NO_2)_3]$ was prepared and its absorption band proved identical with that expected [see Abstract 3592 (1937).] AUTHOR.

3722. Variation of U.V. Spectrum of Naphthalene with pH. M. Gex. *Comptes Rendus*, 207. pp. 153-155, July 11, 1938.—The u.v. spectrum of $C_{10}H_8$ as a function of pH has been investigated. The results make it probable that $C_{10}H_8$ in H_2O behaves as an ampholyte.

A. J. M.

3723. Infra-Red Absorption Spectrum of CD_4 . A. H. Nielsen and H. H. Nielsen. *Phys. Rev.* 54. pp. 118-121, July 15, 1938.—The spectrum of CD_4 has been measured from $3.0\text{ }\mu$ to $10.5\text{ }\mu$ and three regions of absorption were observed. These bands with centres at 2992.8 cm^{-1} , 3103.7 cm^{-1} , 2259.0 cm^{-1} , and 995.86 cm^{-1} , have been

identified as $\nu_1 + \nu_4$, $\nu_3 + \nu_4$, ν_3 , and ν_4 by analogy with CH_4 . The line spacings obtained from these bands in CD_4 are $\Delta\nu_{\nu_1 + \nu_4} = 7.17 \text{ cm}^{-1}$; $\Delta\nu_{\nu_3 + \nu_4} = 5.01 \text{ cm}^{-1}$, $\Delta\nu_3 = 4.52 \text{ cm}^{-1}$; $\Delta\nu_4 = 3.42 \text{ cm}^{-1}$, as compared with 5.3 cm^{-1} , 13.5 cm^{-1} , 9.77 cm^{-1} , and 5.41 cm^{-1} , for the same bands in CH_4 . Values for the ζ 's of Johnston and Dennison have been obtained and are as follows: $\zeta_3 = 0.1465$ and $\zeta_4 = 0.3535$. Utilising the line spacings given above and the expression $\Delta\nu_3 + \Delta\nu_4 = 3h/8\pi^2 A$ derived by Johnston and Dennison the value $1.044 \times 10^{-39} \text{ gm.cm}^2$, is obtained for the moment of inertia A .

AUTHORS.

3724. Spectra of NiCl, CoCl and FeCl. K. R. More. *Phys. Rev.* 54. pp. 122–125, July 15, 1938.—Emission spectra in the region 3800 to 6000 Å which are attributed to the molecules NiCl, CoCl and FeCl have been excited by means of h.f. discharges in silica tubes containing NiCl_2 , CoCl_2 and FeCl_2 , respectively. Vibrational analyses of four systems of NiCl and three systems of CoCl are given. No regularities were found among the FeCl bands.

AUTHOR.

3725. Vacuum U.V. Absorption Spectra of Halogen Acids. W. C. Price. *Roy. Soc., Proc.* 167A. pp. 216–227, Aug. 5, 1938.—The absorption spectra of HI, HBr and HCl have been investigated in the vacuum ultra-violet. The bands observed are due to the excitation of a non-bonding $n\pi$ electron and are the strong resonance bands approaching the $^2\Pi_{1/2}$ states of the molecular ion. They start at 1762, 1491 and 1331 Å for HI, HBr and HCl respectively. In the case of HI a well-developed Rydberg series of bands was found approaching the $^2\Pi_{1/2}$ state of HI^+ , the limit of which corresponded to $10.990 \pm 0.005 \text{ V}$. It was not possible to establish with certainty Rydberg series going to $^2\Pi_{1/2}$ of HI^+ or to any of the $^2\Pi$ states of HBr^+ or HCl^+ . However, from correlations made amongst the bands of the different acids and with the corresponding transitions in the methyl halides, the mean ionisation potentials (i.e., $\text{HX} : ^1\Sigma \rightarrow \text{HX}^+ : ^2\Pi$) are determined to be 10.71, 12.04 and 12.84 V for HI, HBr and HCl respectively, the probable error being about 0.1 V.

AUTHOR.

3726. Kinetics of OH Radicals as Determined by Their Absorption Spectrum. Part III. Quantitative Test for Free OH; Probabilities of Transition. O. Oldenberg and F. F. Rieke. *J. Chem. Phys.* 6. pp. 439–447, Aug., 1938.—(1) In order to make the OH absorption bands applicable to a quantitative chemical test for free OH their probability of transition (f value) was measured by the concentration of "dispersion electrons" in a known concentration of OH. (2) This concentration of OH is produced by water vapour dissociated at 1473°C ., the equilibrium of which was computed. (3) The concentration of the "dispersion electrons" was measured by photometry of the absorption lines photographed with high resolving power. (4) The f values of the various absorption lines are given in a table. The most intense lines have f values of the order of magnitude 2×10^{-4} . The accuracy is estimated to be 15%, the sensitivity (smallest detectable pressure under the conditions of the present experiment), 0.01 mm. (5) Comparison with other f values leads to the conclusion that the OH absorption band belongs to a half-forbidden transition. The lifetime of the excited state is computed as approximately 4×10^{-6} . [For Part II see Abstract 698 (1937).]

AUTHORS.

3727. CdF Spectrum. R. W. B. Pearse and A. G. Gaydon. *Phys. Soc., Proc.* 50. pp. 711–713, Sept. 1, 1938.—The spectrum observed

by Asundi, Samuel and Zaki-uddin [see Abstract 1156 (1935)] and attributed by them to CdF, has been identified with the known spectrum of CaF. New experimental work with CdF is briefly described. Mention is also made of absorption bands incorrectly attributed to CdBr and CdI. AUTHORS.

3728. Presence of Infra-Red Adsorption Band (OH)_s in the Intramolecular Hydrogen Bond. R. Freymann. *Comptes Rendus*, 206. pp. 1812-1814, June 13, 1938.—Contradictory evidence regarding the absence of the (OH)_v band characteristic of free molecules, *i.e.*, molecules containing intramolecular H bonds, *e.g.*, salicylaldehyde and acetylacetone, is in opposition to the theory proposed by the author that chelation, keto-enol isomerism, molecular association, etc., have a common origin in H bonds and that the bonds may be intra- or inter-molecular. Examination of spectra between 0.8 μ and 1.2 μ confirms the common origin of the intra- and inter-molecular bonds and demonstrates that the (OH)_s band appears in intramolecular as well as in intermolecular compounds. The (OH)_v band is not shown by intramolecular compounds. W. R. A.

3729. Attribution of Band Lines to Causes Other than Rotation. H. Deslandres. *Comptes Rendus*, 206. pp. 1844-1848, June 20, and 207. pp. 7-11, July 4, 1938.—In previous papers [see Abstract 2900 (1938)] the vibration and rotation frequencies of molecules have been expressed in terms of a universal constant d , and the number of electrons involved. For H₂O the strongest absorption (vibration) is a harmonic of all the arithmetical series of rotation frequencies. The rule is supposed to be general and is illustrated by four cases. The results are extended to Zn(C₂H₅)₂ and CH₃CH : CH.CO.N(CH₃)₂. It is concluded that the relationship between the frequencies of the molecule and the activated levels of the atoms is such that the radiations emitted by different parts of the molecule are the same or only slightly different. H. G. C.

3730. Mean Absorption and Equivalent Absorption Coefficient of a Band Spectrum. W. M. Elsasser. *Phys. Rev.* 54. pp. 126-129, July 15, 1938.—The note deals with the absorption of a band in which the lines have the dispersion form; the effect of the overlapping of neighbouring lines upon the absorption is taken into account. The analytical problem can be solved for a periodic pattern of lines with equal intensity S , width $2a$ and distance d from each other. Simple expressions are derived for the limiting cases of small and large a/d . In the latter case the transmission by a layer of thickness x is given by $I = I_0 e^{-(Sx/a) \tanh(2\pi a/d)}$. It appears that this formula gives a fairly good mean approximation even for small values of a/d , while the true transmission in this case is not exponential. It is shown that in problems of radiative transfer and radiative equilibria this approximate formula for the transmission can be used; *i.e.*, the factor of x in the above exponent may be substituted in the equations of transfer as equivalent of a mean absorption coefficient. AUTHOR.

***3731. Production of Continuous Spectra by Electrical Excitation of Rare Gases. White Light.** M. Laporte. *J. de Physique et le Radium*, 9. pp. 228-236, June, 1938.—An experimental arrangement for the electrical excitation of rare gases to give continuous emission spectra is described. The influence of the nature of the gas and of the diameter of the tube are discussed. Distribution of spectral energy is considered

and possible applications are suggested. [See also Abstract 3605 (1937).]

W. R. A.

3732. Continuous U.V. Absorption Spectrum of Iodine Monochloride. J. L. Binder. *Phys. Rev.* 54. pp. 114-117, July 15, 1938.—It is shown that the absorption of light in ICl gas follows Beer's law, at least up to the concentrations used here, namely 4×10^{-4} mole/l. The absorption coefficients of ICl were measured at a number of wave-lengths and at several temperatures in the u.v. continuous band and the partial absorption coefficients derived from them. The effective amplitude of vibration of the electron producing this band was determined from the absorption coefficient curves. An attempt to measure the dissociation of ICl spectrophotometrically showed that the visible continuous band and the ultra-violet continuous band broadened out at high temperature to overlap completely the continuous u.v. band of Cl_2 . AUTHOR.

3733. Zeeman Effect of an Abnormal Series of Argon. P. Jacquinot. *Comptes Rendus*, 206. pp. 1635-1638, May 30, 1938.—The series p^{5ns} of A shows important anomalies; only the 4s and 5s terms are interpretable on Houston's theory [see Abstract 2483 (1929)]. Coincidence of the levels $7s_2$ and $8s_4$ had been predicted but an examination of the Zeeman effect has not confirmed this. A small Paschen-Back effect between $7s_2$ and $7s_3$ is reported. W. R. A.

3734. Accuracy of Linear Law in Simple Cases of Zeeman Effect. P. Jacquinot. *Comptes Rendus*, 206. pp. 1960-1963, June 27, 1938.—An appreciable Paschen-Back effect is observed at 45,000 gauss for the 4680 and 4722 Å lines of Zn and for the 6334 and 6383 Å Ne lines. The linear law is obeyed to approximately 1 in 1000. No Kapitza effect is discernible at 45,000 gauss. W. R. A.

3735. Axiality of Emission of Light from the Hydrogen Atom in an Electric Field. J. Stark, R. Ritschl and H. Verleger. *Phys. Zeits.* 39. pp. 503-517, July 1, 1938. *From the Reichsanstalt.*—The Stark effect components of $H\alpha$, $H\beta$ and $H\gamma$ emitted by moving H atoms produced in a canal ray are observed to have an asymmetrical distribution of intensity which varies in dependence on the experimental conditions. Thus the degree of asymmetry depends on whether the emission of the atoms is of the pressure or the decay type, whether the canal ray and electric field are in the same or opposite directions and on the direction of observation of the emission relative to the field. Variation in the ratio of the polarisation of parallel and perpendicular field components of $H\alpha$ depending on the direction of observation and the type of excitation is also observed; the polarising effect of the field is found to be smaller for stationary than for moving H atoms. An explanation of all the observed results is given on the bases of Stark's conception of a ring structure for the electron and a consequent axial adjustment of a H atom in an electric field. J. E. K.

3736. Light Emission and Ionisation of States of Motion of the Hydrogen Atom in Strong Electric Fields. J. Stark and R. Ritschl. *Phys. Zeits.* 39. pp. 517-522, July 1, 1938. *From the Reichsanstalt.*—Attention is drawn to a spectrogram of the lines $H\beta$ to $H\epsilon$ in a strong electric field published in 1930 by v. Trautenberg, Gebauer and Lewin, which was reproduced by Sommerfeld in his book, "Atomic Structure and Spectral Lines," and described as a lo Surdo photograph showing that the Stark components of the Balmer lines cease to exist above certain field strengths which diminish as the series is ascended; later the spectrogram was stated by Lanczos to support his

wave-mechanical deduction that the states of motion of H atoms in an electric field become unstable above certain limits and cease to exist. The authors produce evidence to show that the spectrogram in question was not a lo Surdo photograph but a canal-ray photograph taken in a transverse field behind the cathode. Such canal-ray photographs are taken by the authors for $H\gamma$ and $H\delta$ in fields up to 470 kV/cm.; noteworthy changes of intensity of the Stark components with increasing field strengths are observed and find a rational explanation on the basis of Stark's conception of a H atom which in its permissible states of motion assumes definite axial orientations with respect to an electric field. J. E. K.

3737. Raman Spectrum Identification of a Mercuric Chlorobromide. M. L. Delwaulle. *Comptes Rendus*, 206. pp. 1965-1967, June 27, 1938.—The Raman spectrum of a solution of $HgCl_2$ and $HgBr_2$ is not a simple superposition of the spectra of the solutions of the separate salts. In addition to a line at 320 cm^{-1} . due to $HgCl_2$, and to one at 205 cm^{-1} . due to $HgBr_2$, there are other lines at 232 (strong), 347 (medium) and 139 cm^{-1} . (faint). Similar results were got (a) by evaporating alcoholic solutions of the mixed salts, and then using the crystals so obtained, for Raman scattering, and (b) by fusing the solid salts together in equimolecular proportions. A simple calculation shows that two of the frequencies of vibration to be attributed to $Cl\cdot Hg\cdot Br$ should be approximately 242 and 352 cm^{-1} ., in good agreement with the observed values. A. C. M.

3738. Raman Spectrum of BF_3 . D. M. Yost, D. DeVault, T. F. Anderson and E. N. Lassette. *J. Chem. Phys.* 6. pp. 424-425, Aug., 1938.—The Raman spectrum of BF_3 was photographed using a purified preparation obtained from the thermal decomposition of $C_6H_5N_2BF_4$. Of the lines observed, that with the frequency 888 cm^{-1} . is certainly, and the band at $439-513\text{ cm}^{-1}$. is probably due to BF_3 . The Raman frequencies and the infra-red results of Bailey *et al.* are assigned to the fundamental modes of vibrations. AUTHORS.

3739. Raman Spectra of H_2S and D_2S (Gas, Liquid and Solid). G. M. Murphy and J. E. Vance. *J. Chem. Phys.* 6. pp. 426-429, Aug., 1938.—Raman spectra have been obtained for H_2S and D_2S as gas, liquid and solid. Only one frequency has been obtained in the gas and liquid although three are permitted by the selection principles. In the solids, a single line and a close doublet have been obtained. With the available data it is not possible to make quantitative calculations of isotope effect, force constants, angle or anharmonic factors. AUTHORS.

***3740. Photoelectric Spectrophotometers.** R. H. Sewig. *A.T.M.* No. 83. J385-1, May, 1938.—Various types of commercially available spectrophotometers are described under the headings: s.p. using colour filters, s.p. using monochromator, self-registering s.p. Sources of error in the different methods are considered. W. S. S.

***3741. Raman Effect Apparatus.** A. H. Pfund. *J.O.S.A.* 28. pp. 264-265, July, 1938.—A relatively inexpensive yet very efficient piece of apparatus for the routine study of the Raman effect is described. Two automobile headlight reflectors are used facing one another, the mercury lamp occupying the position of the headlight bulb in the one whilst the Raman tube occupies the same position in the other reflector. The radiation is taken to the spectrograph by a right angled prism attached to the end of the Raman tube which is outside the reflector. A. H.

***3742. Two-Prism Spectrograph for Studying U.V. Sources of Radiation and Photographic Emulsions.** P. Gesteau. *Comptes*

Rendus, 206. pp. 1630-1631, May 30, 1938.—An apparatus consisting of a two-prism spectrograph, fitted with a synchronous motor which rotates simultaneously the photographic plate and a polariser, is described and its use indicated.

W. R. A.

***3743. Wire-Grating Spectrometer for Far Infra-Red.** P. Barchewitz and M. Parodi. *Comptes Rendus*, 206. pp. 1891-1893, June 20, 1938.—The grating used consists of 200 wires of Cu, 0.25 mm. in dia., spaced 0.25 mm. apart; gilded mirrors are used to collimate and focus the beam; and a radiomicrometer is used for measuring the radiation. The first-order spectrum is used, and screens of powdered quartz on paraffin plates 1 mm. thick, and paraffin alone, are used to filter out the unwanted orders of the near infra-red. The instrument is intended for the region 20-100 μ . Wave-lengths are measured to a precision of 1 μ ; slit-widths correspond to a wave-band of 2 μ ; and the radiomicrometer deflections allow an accuracy of 5% in absorption measurements to be obtained, using an Auer burner as source.

D. H. F.

***3744. Comparator for Projection of Spectra on a Screen.** A. Gatterer. *Zeits. f. Instrumentenk.* 58. pp. 271-276, July, 1938.—The author has developed an apparatus which compares and measures two spectra on the same screen. The light from two lamps passes through two lens systems and the photographic plates to be compared on two plane mirrors which reflect the light on to the screen. By turning the mirrors, the images of the spectra can be brought into contact with each other on the screen. Two magnifications which can be varied to a certain extent, are available which allow two spectra of different dispersion to be compared. A small transparent glass plate which is provided with a millimeter-scale and a vernier, can be laid over the screen for the actual measurement of the spectra. The screen can be replaced by a photographic camera for taking photographs of the magnified spectra.

L. K.

See also Abstracts 3590, 3760, 3800.

TRANSMISSION.

***3745. Spectral-Transmissive Properties and Use of Coloured Eye-Protective Glasses.** W. W. Coblenz and R. Stair. *Bureau of Standards, Circ. No. C421*. [28 pp], 1938.—In response to the continuing demand for information on coloured glasses for protecting the eyes from glare and from injurious amounts of u.v. and infra-red radiation, this circular gives the spectral-transmissive characteristics of various coloured lenses that are marketed under a variety of trade names, such as Amethyst, Avitint, Azurlite, Bluelite, Calobar, Cerulite, Cruxite, Diantho-Lite, Kalichrome, Noviol, Noviweld, Polaroid, Roselite, Soft-Lite, Solarex, Viopake, etc. For convenience in exposition of the data, the various tinted lenses are grouped under the colour that predominates in transmission—amber, green, blue, etc. Introductory to the presentation of the data, various important incidental questions are discussed, including elimination of glare, distortion of colours, confusion of traffic signals, the hazard in wearing coloured glasses when driving at night, the importance of having standard shades, etc.

AUTHORS.

3746. Equivalent Luminous Intensity of Rotating Beacons. G. K. Neeland, M. K. Laufer and W. R. Schaub. *J.O.S.A.* 28. pp. 280-285, Aug., 1938.—This paper describes a method of measuring the apparent change in the intensity of a beacon as its rate of rotation is

altered. The equivalent intensity of several beacons is plotted against the duration of the flash. It is found that Blondel and Rey's law for abrupt flashes also seems to describe the equivalent intensity of service beacons to a first degree of approximation. AUTHORS.

3747. Flashing Character of Aerodrome Floodlight Beacons. W. M. Hampton and J. G. Holmes. *Phys. Soc., Proc.* 50. pp. 642-654, Sept. 1, 1938.—A simple mathematical method is developed for calculating the frequency of the flash, and the distribution of intensity during the flash, when a floodlight is tilted and rotated so as to form a flashing beacon. The results of a number of typical calculations are given as diagrams and these may be used to estimate the results given by other distributions and conditions which would not be so readily calculated. Comparison is drawn between the various methods of tilting and the ideal requirements of an airway beacon. AUTHOR.

See also Abstract 3541.

VISION.

3748. Effect of Adaptation on Differential Brightness Discrimination. K. J. W. Craik. *J. Physiol.* 92. pp. 406-421, May 14, 1938.—The sensitivity of the eye to differences in brightness has been investigated after adaptation to a wide range of intensities greater, equal to, and less than, those at which it was tested. *The apparatus provided an adapting field of 45° and a brightness range of $1/2500$ th to 4000 equiv. f.c. Test fields of $1\frac{1}{2}^\circ$ and 36° were also obtainable over the same range of illuminations. The differential threshold is, in general, found to be lowest, approximately 1%, when the "test" and "adapt" illuminations are equal. It is raised very considerably by adaptation to illuminations greatly exceeding the test intensity. Adaptation to illuminations far below the test intensity has a similar, though less marked effect, which is greater when using a large test field than with a small centrally fixated one. A tentative interpretation of the results is given. W. D. W.

3749. Brightness Discrimination and Duration of Increment. C. H. Graham and E. H. Kemp. *J. Gen. Physiol.* 21. pp. 635-650, May 20, 1938.—The brightness discrimination has been measured for various durations of the increment of intensity, ΔI , from 0.002 to 0.5 sec. $\Delta I/I$ values at constant intensity are highest for the shortest duration and decrease with an increase in duration up to the limits of a critical exposure time. At durations longer than the critical duration, the ratio $\Delta I/I$ remains constant. The Bunsen-Roscoe law holds for the photolysis due to ΔI . This is shown by the fact that, within the limits of a critical duration, the product of ΔI and exposure time is constant for any value of prevailing intensity, I . The critical duration is a function of intensity. As intensity increases the critical duration decreases. W. D. W.

3750. Impulses in the Optic Nerve of Pecten. H. K. Hartline. *J. Cell. and Comp. Physiol.* 11. pp. 465-478, June 20, 1938.—The retina of the scallop, *Pecten irradians*, possesses two layers of visual cells. Fibres from the proximal layer show a discharge of impulses during illumination of the eye, with properties characteristic of simple visual end organs. Fibres from the distal layer respond only to cessation of illumination, or a reduction in its intensity. These "off" responses are similar in all respects to the discharges of impulses in the "off" response fibres of the vertebrate retina. If the distal cells in the Pecten retina

are primary sense cells independent of the proximal layer, these experiments establish the existence of a new kind of sensory cell, capable of being excited only by the removal of a stimulating agent. Alternatively, the distal cells may be ganglion cells, depending on the proximal cells as the source of their excitation, although this is contrary to anatomical opinion.

W. D. W.

3751. Influence of Acoustic Stimuli Upon the Limits of Visual Fields for Different Colours. P. A. Yakovlev. *J.O.S.A.* 28. pp. 286-289, Aug., 1938.—The acoustic excitations may influence the limits of visual fields for colour stimuli. The limits of the visual fields for the green and blue colours expand under the influence of acoustic stimuli; for the orange-red colour, they contract; for the extreme red colour they do not change at all. The colour sensibility of the peripheral part of retina changes under the influence of acoustic stimuli very much like the change of the colour sensibility of the macular regions of the retina.

AUTHOR.

3752. Anomalous Trichromatism and its Relation to Normal Trichromatism. J. H. Nelson. *Phys. Soc., Proc.* 50. pp. 661-702, Sept. 1, 1938.—The characteristics of six deuteranomalous observers and one protanomalous observer have been examined. In the case of the former it has been shown that, in contrast with what occurs in normal trichromatism and dichromatism, it is not possible to take mean values as representative of the deuteranomalous observer. This fact combined with the results of the statistical survey with the Nagel anomaloscope, suggests that anomalous trichromatism is an intermediate state between dichromatism and normal trichromatism. In the case of the protanomalous this transition would seem to be of a continuous nature, but for the deuteranomalous there is a subsidiary maximum in the distribution curve.

AUTHOR.

3753. Colour Sensations Produced by U.V. Light. A. G. Gaydon. *Phys. Soc., Proc.* 50. pp. 714-719; *Disc.*, 719-720, Sept. 1, 1938.—The crystalline lens of the author's left eye has, as the result of an accident, been destroyed. The eye is now sensitive to u.v. light of quite low intensity. The sensation between 3600 and 3100 Å is blue, not violet. The sensations produced by extremely faint u.v. light on the dark-adapted retina are discussed; the behaviour is essentially similar to that in normal scotopic vision, the light appearing colourless and the peripheral region being more sensitive than the fovea.

AUTHOR.

3754. Absorption Spectrum of Visual Purple. A. M. Chase and C. Haig. *J. Gen. Physiol.* 21. pp. 411-430, March 20, 1938.—The absorption spectra of visual purple solutions extracted by various methods have been measured with a sensitive photoelectric spectrophotometer and compared with the classical visual purple absorption spectrum. Hardening the retinas in alum before extraction yielded visual purple solutions of much higher light transmission in the blue and violet, and investigations of the colour at various pH values showed that, over the pH range from 5.5 to 10.0, the visual purple colour purity was greatest at the low pH. The colour purity was also greater the higher the temperature, up to 40° C. In no case was the symmetry of the unbleached visual purple absorption spectrum improved sufficiently for it to resemble the classical curve. It is suggested that the classical curve is that of the

light sensitive group only, whereas the absorption curve obtained in the present work represents the molecule as a whole. W. D. W.

See also Abstracts 3745 and

2763B. Visibility of Reading Tasks. L. H. Brown, L. G. Gianini and T. A. Robinson.

X-RAYS.

3755. L-Series of Ag. L. G. Parratt. *Phys. Rev.* 54. pp. 99-114, July 15, 1938.—With a new two-crystal vacuum spectrometer a systematic and precise study of 36 L-series emission lines of Ag has been made which includes measurements of wave-lengths, relative intensities, line widths and indices of asymmetry. These lines include 21 satellite lines. The contours of the three L absorption edges of silver were also recorded. From these data have been determined the widths of all the energy levels for single ionisation of silver. From the widths of satellite lines are discussed the widths of certain states of double ionisation. AUTHOR.

3756. Measurement of Supervoltage X-Rays With the Free-Air Ionisation Chamber. L. S. Taylor, G. Singer, and A. L. Charlton. *Bureau of Standards, J. of Research*, 21. pp. 19-44, July, 1938.—A free-air ionisation chamber for the measurement of supervoltage X-rays is described. It is built on the guarded-field principle and of such size as to permit measurements for X-ray excitation voltages from 150 to 350 kV at atmospheric pressure and 200 kV upward at elevated pressures. The electrode system is contained in a pressure cylinder of such size as to give an equivalent plate spacing of 4 m. at a pressure of 10 atm. The chamber characteristics have been studied in the range of 200 to 400 kV. The most important finding is the required increase in plate separation at the higher voltages. While reasonable, this is at variance with the findings of other workers. From the measurement of the plate separation for full electronic equilibrium, electron ranges may be obtained. To carry out these measurements it was necessary to design and construct a h.v. plant capable of extreme steadiness of operation. This was accomplished with a four-stage rectifier having valves operated on a single pumping system. Potentials were carefully distributed through the system with the result that the voltage could be measured and controlled within $\pm 1\%$, which also represents the variation in tube output. The X-ray tube is of the simple 4-stage type, made up of pyrex cylinders. By means of an insulated target, only the target current is measured. AUTHORS.

3757. X-Ray Investigation of the Form of Acetylsalicylic Acid in Certain Sugars. S. S. Sidhu. *J. of Applied Physics*, 9. pp. 546-550, Aug., 1938.—X-ray studies of samples made of sucrose, glucose, and acetylsalicylic acid were made to determine if the latter is in solid solution with the sugars. The main constituent of the samples was sucrose and the amounts of acetylsalicylic acid varied from 1.5 to 20%. The samples were prepared by melting and heating the sugar combinations to 160°C., removing essentially all the water and allowing to cool. The acetylsalicylic acid was then incorporated in one set of samples at 140°C. and in another at a temperature between 110-115°C., that is, both above and below the melting point (133-5°C.) of the compound. The former samples were far more hygroscopic than the latter, but in neither case did the acetylsalicylic acid seem to form a solid solution with the rest of the constituents. AUTHOR.

See also Abstracts 3459, 3594, 3669 and

2695B. X-Ray Stereometer. C. D. Moriarty.

HEAT.

CALORIMETRY.

See Abstracts 3774, 3789.

CONDUCTION.

3758. Flux Distribution of Heat Generated Between Two Media in Poor Contact. P. Vernotte. *Comptes Rendus*, 207. pp. 124-126, July 11, 1938.—Heat generated between two media has been shown to commence to flow into these media proportionally to $\sqrt{k\rho c}$ (where k , c and ρ are the thermal conductivity, specific heat and density) when the media are in good thermal contact [see Abstract 2927 (1938)]. Equations are now derived in which allowance is made for surface resistances which hinder the heat flow. Attention is directed to a paradox in that the initial heat distribution seems to depend on the boundary conditions, a result which is explained as resting on an obscure property of the equations rather than on physical facts. R. W. P.

3759. Thermal Conductivity of Metals. R. E. B. Makinson. *Cambridge Phil. Soc., Proc.* 34. pp. 474-497, July, 1938.—The methods used to measure separately the electronic and lattice heat conductivities, κ_e and κ_g in a metal are reviewed, and it is pointed out that care is necessary in interpreting the results in view of the underlying assumptions. The equations given by Wilson for κ_e and for the electrical conductivity σ are used to plot the theoretical values of the electronic Lorentz ratio $L_e = \kappa_e / \sigma T$ as a function of T , both for the monovalent metals and for a model metal with 1.8×10^{-2} conduction electrons per atom, which is taken to represent Bi sufficiently accurately for this purpose. Curves for κ_e and κ_g as functions of T are given in both cases, and these, together with a comparison of the observed Lorentz ratio and L_e show that in the monovalent metals κ_g is unimportant at any temperature, but in Bi it plays a major part at low temperatures, in agreement with experimental conclusions. Quantitatively the agreement is good for Cu and, as far as the calculations go, reasonable for Bi. Scattering of lattice waves at the boundaries of single crystals (including insulators) at temperatures of a few degrees absolute is shown to be consistent with the experiments of de Haas and Biermasz on KCl and to be responsible for the rise in thermal resistance in this region as suggested by Peierls. The assumption in the theory of electronic heat conduction that the lattice energy distribution function has its thermal equilibrium value is examined in an appendix. The conclusion is that it should be satisfactory though the proof of this given by Bethe is seen to be inadequate. AUTHOR.

3760. Energy Exchanges at Boundary Surfaces. H. J. de Boer. *Zeits. f. Elektrochem.* 44. pp. 488-497, Aug., 1938.—This subject is reviewed under 9 headings, viz.: (1) Heat exchanges between gas molecules and solid walls, with a discussion of the accommodation coefficient. (2) Exchange of potential energy into heat. (3) Activated adsorption. This section considers the adsorption of H_2 and O_2 at metallic surfaces. (4) Surface reactions. (5) Depression of the work of ionisation by adsorbed atoms. (6) Surface migration. (7) Light absorption in the adsorbed state; here as examples are studied the absorption spectra of Rhodamin B in aqueous solution and at a CaF_2 surface. The section also contains an investigation of active spots with respect to van der Waals adsorption,

and the adsorption of dipole molecules (OH-dipoles), the examples studied being iodine, CsH, para nitrophenol and alizarin adsorbed at CaF_2 surfaces. (8) Optical sensitisers. (9) Changes in the structure of a surface, e.g., swelling by adsorption and recrystallisation. The paper is illustrated by 15 diagrams. H. H. Ho.

3761. Heat Conduction in a Medium Having Thermal Properties Depending on the Temperature. M. R. Hopkins. *Phys. Soc., Proc.* 50. pp. 703-706, Sept. 1, 1938.—Typical standard calculations in the theory of heat conduction are modified to allow for the variation of the thermal properties of the medium with temperature. AUTHOR.

3762. Dependence on Thickness of the Thermal Resistance of Crystals at Low Temperatures. W. J. de Haas and T. Biermasz. *K. Onnes Lab., Leiden, Comm. No. 253b. Physica*, 5. pp. 619-624, July, 1938. *In English.*—In continuation of previous work [see Abstracts 760 and 2071 (1938)], values are tabulated for the thermal resistance of four silica rods (perpendicular to the principal axis) of 0.216, 0.359, 0.454 and 0.775 cm. dia. at 1.67-89.4° K. The resistance (w) is not inversely proportional to the diameter (d); for a sufficiently large value of d (3-4 cm.) saturation would be attained. The saturation limit for KCl is attained at a thickness of about 1 cm.; the smaller value in this case is possibly attributable to the smaller dimensions of the mosaic crystals in KCl. It is possible that the reflection coefficients of the mosaic crystals of KCl and SiO_2 for elastic waves are different. The phenomena are explainable in terms of the hypothesis of reflection of elastic waves by the walls of the rods and the mosaic crystals. J. S. G. T.

3763. Pressure Coefficient of Thermal Conductivity of Metals. C. Starr. *Phys. Rev.* 54. pp. 210-216, Aug. 1, 1938.—The pressure coefficients of thermal conductivity of Cu, Ag and Au were determined by means of an improved longitudinal heat flow method. The results indicate that the ratio of the thermal to the electrical conductivity (the Wiedemann-Franz ratio) for these metals, over a pressure range of 12,000 kg./cm²., has a small positive coefficient of approximately 1% in 10,000 kg./cm². These results are at variance with those of Bridgman who used a similar method but found that the pressure coefficient of the Wiedemann-Franz ratio may be either negative or positive and is more often negative. Experiments are reported which prove that the negative coefficients found by Bridgman were due to a systematic convection error undiscovered in his longitudinal heat flow method. It is reasonable to suppose that the positive pressure coefficient of the Wiedemann-Franz ratio is due to the non-electronic part of the thermal conductivity, and this assumption is further supported by the correlation between these positive coefficients and the volume compressibilities of the metals. AUTHOR.

CONVECTION.

3764. Non-Stationary Free Convection. D. A. Frank-Kameneckij. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 7. pp. 409-412, 1938. *In English.*—Dimensional analysis is applied to the thermal and hydrodynamical equations which represent free convection in the initial non-stationary stage. It is shown that the temperature distribution and the coefficient of heat transfer can be expressed as functions of two non-dimensional terms t/τ_1 and t/τ_2 . The values of τ_1 and τ_2 are d^2/κ and $(d/g\beta\theta_0)^{1/2}$ respectively, where d =length parameter, κ =thermal diffusivity, g =gravitation acceleration, β =coefficient of

expansion and θ_0 = characteristic temperature difference. Since $(\tau_1/\tau_2)^2 = \text{GrPr}^2$, it follows that the functions can be so transformed that only Gr and one of the arbitrarily chosen quantities τ_1 or τ_2 remains. The limiting case of $\tau_1 \gg \tau_2$, i.e., $\text{Gr} \gg 1$ has already been discussed by the author [see Abstract 761 (1938) and following Abstract.] R. W. P.

3765. Temperature Distribution in Reaction Vessel and Stationary Theory of Thermal Explosions. D. A. Frank-Kameneckij. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 7. pp. 413-414, 1938. *In English.*—By a further application of dimensional analysis to similar equations [see preceding Abstract] relations among non-dimensional parameters are established which enable the critical condition for inflammation to be determined in terms of one parameter δ . This parameter assumes a critical value for each vessel. For low gas pressures and small vessels $\text{Gr} \rightarrow 0$, and convection becomes negligible. Critical values of δ are calculated for this case for spherical, cylindrical and plane parallel vessels, and these are found to be in satisfactory agreement with experimental determinations. R. W. P.

FUSION AND SOLIDIFICATION.

3766. Melting Points of Paraffins and Fatty Acids. E. B. Moullin. *Cambridge Phil. Soc., Proc.* 34. pp. 459-464, July, 1938.—The plot of the melting points of paraffins against the number of C atoms is a smooth curve. Curves for fatty acids are similar but members containing an odd number of C atoms lie on one curve ("odd curve"), whilst those containing an even number lie on another ("even curve"). The paraffin curve and acid curves can be superposed under the following conditions; the ordinate scales (melting points) are multiplied by 2 and the curves are displaced bodily by $+15^\circ$ for the "odd curve" and by $+6^\circ$ for the "even curve." This is explained by the fact that, as X-ray examination of crystals of fatty acids has shown, the carboxyl groups are contiguous and that double molecules are formed. Relationships between melting points and chain lengths are discussed. W. R. A.

***3767. Freezing Point of Methanol; Simple Cryostat. E. E. Roper.** *Am. Chem. Soc., J.* 60. pp. 1693-1695, July, 1938.—A simple cryostat is described which is applicable to the determination of freezing points below 0° and data are appended describing the operation of the cryostat during the freezing point determination of a methyl alcohol sample. The freezing point of a particularly pure sample of methanol prepared by Jones and Fornwalt was determined to be $-97.68 \pm 0.02^\circ$. A short discussion is given of the freezing point-density relationship. AUTHOR.

See also Abstract 3783.

TEMPERATURE.

3768. Wall Temperature and Dwelling Comfort. H. Roose. *Gesund. Ing.* 61. 24. pp. 325-329, June 11, 1938.—About half the heat loss of the human body is due to radiation, the individual synthesises the effects of wall and air temperatures into a general sensation expressed by $(0.45 \theta_{\text{wall}} + 0.55 \theta_{\text{air}})$. The author describes a new method of measuring wall temperature—two balls, one nickel plated and burnished (4%) and one black painted (96.5%) are suspended a yard above the floor and maintained electrically at 36.5°C. ; from the difference between the currents required the wall temperature may be calculated. Tests on 14

rooms show that a 25 cm. wooden wall is equivalent to a masonry wall 80 cm. thick, with or without wood facing. The temperature of masonry walls is $0.5-1^{\circ}$ lower, and with walls of hollow concrete block with cork insulation about $1-2^{\circ}$ C. lower than for the wooden walls. D. R. H.

***3769. Electrolytic Resistors for D.C. Applications in Measuring Temperatures.** D. N. Craig. *Bureau of Standards, J. of Research*, 21. pp. 225-233, Aug., 1938.—An improved electrolytic resistor, developed primarily for temperature indicators on radio meteorographs, is described. On such instruments variable unidirectional currents are employed. Resistors to be used successfully in such applications require (1) large temperature coefficient, (2) low freezing point, (3) light weight, (4) reversibility, (5) stability of calibration, (6) hermetical sealing, (7) high resistance with minimum inductance and capacitance, and (8) rapid response to temperature changes. The resistor consists of Cu electrodes in a capillary tube filled with a solution of Cu_2Cl_2 , HCl and EtOH. Various proportions may be used in obtaining solutions which will freeze at -75° C. The alcohol affords a convenient means of adjusting the resistance of a particular resistor to the desired value. Within reasonable limits of impressed voltage, the resistors have been found reliable over a temperature range of $+30^{\circ}$ to -75° C. They respond satisfactorily to changes in temperature and hold their calibration for periods of time much in excess of that required for a flight. Ratios of the resistances R_t/R_0 measured with d.c. agree with those measured with a.c. Temperature indications are believed to be accurate within 1° C. even at the lowest temperature.

AUTHOR.

***3770. Sensitive Method of Temperature and Pressure Measurement.** S. Zamenhof. *Acta Physica Polonica*, 7. 1. pp. 1-4, 1938. *In English*.—The method is based on inserting a thin resistance wire into the capillary tube of a mercury thermometer, so that the rising thread short-circuits the wire and reduces its resistance. The possibility of applying a similar method to pressure measurements is also mentioned.

AUTHOR.

3771. Production and Measurement of Low Temperatures. K. R. Dixit. *Current Science*, 12. pp. 589-599, June, 1938.—The production and measurement of low temperatures, attainable by the liquefaction and solidification of gases, over the period 1823 to the present day, are interestingly reviewed. Temperatures lower than 0.71° K. are attainable by the method of adiabatic demagnetisation of paramagnetic salts. The lowest temperature hitherto attained is 0.0044° K., reached by the adiabatic demagnetisation of a mixture of chrome- and potash-alum. The possibility of attaining still lower temperatures by utilising the relatively short time (about 1 sec.) for exchange of energy between the nuclear spins and conduction electrons of metals is suggested. J. S. G. T.

See also Abstracts 3762, 3767, 3854, 3855, 3878.

THERMOCHEMISTRY.

3772. Heat of Solution of Anhydrous AlCl_3 . W. A. Roth and E. Börger. *Zeits. f. Elektrochem.* 44. p. 540, Aug., 1938.—Preparative details are first given of the samples of aluminium chloride employed and are succeeded by a brief description of the experimental procedure followed. The data obtained fluctuated somewhat, but from $N = 4000$ to $N = 9500$, the value of the heat of solution was found to be $+79.45 \pm 0.1$ kg.cal.

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This value is higher than the data of previous authors, but this is ascribed to the greater purity of the AlCl_3 used. H. H. Ho.

3773. Heats of Solution of Calcium and Magnesium Oxides and Hydroxides. K. Taylor and L. S. Wells. *Bureau of Standards, J. of Research*, 21. pp. 133-149, Aug., 1938.

3774. Atomic Heat of Nitrogen in Nitrides. Part I. S. Satoh. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers*, No. 799. pp. 751-760, July, 1938. *In English*.—The atomic heats of N are deduced from the molecular heats of various nitrides for the purpose of applying Neumann-Kopp's law. They were found to have the value of about 2.4 in nitrides of elements with small atomic numbers and about 4 in nitrides of elements with large atomic numbers. As a whole, the values were 2 ~ 5, considerably removed from the value 6.2. The variation of the atomic heats with temperature is also discussed. AUTHOR.

3775. Detonation in Explosives by Thermal Impulse. A. F. Belajev. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 4-5. pp. 267-269, 1938. *In English*.—It is often necessary in practice to deal with the action of some form of thermal impulse in an explosive, and the present investigation attempts to establish the general laws of thermal initiation in the case when the thermal impulse is concentrated in a volume of the order of a few cubic microns in a very short interval of time (10^{-3} - 10^{-4} sec.). Pt wires, of 2 and 5μ dia. and 3 mm. long situated in the explosive, were used as the source of the thermal impulse. It was established that while in the case of volatile explosives the chemical factors were of primary importance in the process of the development of detonation, a considerable part is played by evaporation which, under favourable conditions, may change the whole character of the chemical process and in particular retard the development of detonation and cause the slow combustion to take place from beginning to end in the gas phase. H. H. Ho.

3776. Two-Stage Spontaneous Ignition of Hydrocarbons. A. V. Belov and M. B. Neumann. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 6. pp. 333-336, 1938. *In English*.—Pentane-air mixtures are admitted to a hot steel bomb and the pressure changes are recorded photographically. It is found that the region of 2-stage spontaneous ignition is limited not only with respect to temperature but also with respect to pressure. L. A. W.

See also Abstracts 3524, 3765, 3798.

THERMODYNAMICS.

3777. Complete Diagram of State of Binary Systems with Vapour Pressure Maxima. E. Jänecke. *Zeits. f. phys. Chem.* 182. *Abt. A.* 3. pp. 177-185, 1938.—The equilibrium of binary systems which show a vapour pressure maximum in the presence of the solid state has been investigated. The equilibria when there is formation of a simple eutectic, and of a continuous mixed crystal phase between the two solid phases are particularly considered. A. J. M.

3778. Diagrams of State for Moist Gases. A. Stradelli. *Ricerche di Ingegneria*, 6. pp. 36-42, March-April, 1938.—Examples are given of the method of tracing and using a diagram of state for gaseous mixtures containing a condensible component, in particular for moist air. The method permits the following in detail of transformations with

considerable variations of pressure, and of taking account of existing solid and liquid phases. J. J. S.

3779. Relativistic Study of the Joule-Thomson Effect and Adiabatic Processes in a Gas. Part II. D. V. Gogate. *Phil. Mag.* 26. pp. 166-173, July, 1938.—The Joule-Thomson effect and adiabatic processes in a relativistic non-degenerate gas obeying Fermi-Dirac statistics have been considered in a previous paper [see Abstract 2511 (1938)]. These considerations are now extended for a degenerate gas, *i.e.*, degenerate in the sense of the Fermi-Dirac statistics. Expressions are derived to explain these effects, and the results for the limiting states of a Fermi-Dirac gas, with and without the use of relativity mechanics, are compared. C. J. B. C.

3780. Density of Energy States in Solids. S. H. Bauer. *J. Chem. Phys.* 6. pp. 403-404, July, 1938.—A treatment of the problem using thermodynamic functions of the aggregate which yield equations, the solutions of which are experimentally indistinguishable from those specified by the data. G. C. E.

3781. Solid-Liquid Equilibrium in Argon. O. K. Rice. *J. Chem. Phys.* 6. pp. 472-475, Aug., 1938.—The method of investigating the equilibrium between solid and liquid phases, outlined in a previous paper [see Abstract 3185 (1937)] has been applied to argon. (In this method the intersections of the curves for the thermodynamic quantities $T(\partial S/\partial V)_T$ and $(\partial E/\partial V)_T + P$, plotted as functions of the volume, are used to determine the conditions of equilibrium of the system.) Curves are found for the functions $(\partial S/\partial V)_T$ and $(\partial E/\partial V)_T$ assumed dependent on volume and independent of temperature, which can reproduce with reasonable accuracy most of the melting parameters of argon at high pressures. The significance of these curves is discussed. AUTHOR.

3782. Thermodynamic Properties of Propane. J. D. Kemp and C. J. Egan. *Am. Chem. Soc., J.* 60. pp. 1521-1525, July 6, 1938.—The heat capacity of condensed propane was measured from 15° K. to the boiling point. The melting point was found to be $85.45 \pm 0.05^\circ \text{K.}$, the boiling point $231.04 \pm 0.05^\circ \text{K.}$, the heat of fusion 842.2 ± 0.8 and the heat of vaporisation 4487 ± 4 cal./mole. Vapour pressure measurements were made on liquid propane and the results represented by the equation (liquid propane, 166 to 231°K. ($0^\circ \text{C.} = 273.10^\circ \text{K.}$)) $\log_{10} P_{(\text{Int. cm. Hg})} = -(1325.358/T) + 9.64920 - 0.0118950T + 0.000013420T^2$. The density of propane gas at 298.10°K. and 1 atm. was found to be 1.8325 ± 0.0007 gm./l. At 1 atm. at the boiling point the experimental entropy of propane (ideal gas) was evaluated as 60.45 ± 0.10 cal./deg. per mole. The entropy of propane calculated with the assumption of free internal rotation minus the experimental entropy, $S_{\text{free}} - S_{\text{exp}}$, (at the boiling point), was found to be 3.40 ± 0.3 cal./deg. per mole, which corresponds to a potential barrier of 3300 ± 400 cal./mole hindering the internal rotation of the methyl groups. The entropy of propane (ideal gas, with a 3300 cal./mole barrier) at 1 atm. and 298.10°K. , was found to be 64.7 ± 0.3 cal./deg. per mole (nuclear spin entropy not included). This is the entropy value to be used in thermodynamic calculations. AUTHORS.

3783. Communal Entropy and the Theory of Fusion. O. K. Rice. *J. Chem. Phys.* 6. pp. 476-479, Aug., 1938.—The concept of "communal" entropy, introduced by Hirschfelder, Stevenson and Eyring, is further discussed in this paper. It appears from both theoretical and empirical considerations that the entropy of fusion of simple solids

is *not* primarily concerned with the excitation of communal entropy. A discussion is given of the nature of communal entropy and its manner of excitation. [See Abstract 5394 (1937).] AUTHOR.

3784. Entropy of Ethyl Alcohol from Molecular Data and Equilibrium in Hydration of Ethylene. S. C. Schumann and J. G. Aston. *J. Chem. Phys.* 6. pp. 480-484, Aug., 1938.—The entropy and free energy of ethyl alcohol gas have been calculated from the molecular data at several temperatures on the basis of (a) free internal rotation, (b) restricted rotation (with potentials; about C — C bond = 3000, C — O bond = 10,000 cal.). The latter values are in perfect agreement with those from the third law and from the equilibrium data on the hydration of ethylene. AUTHORS.

3785. Entropy of Acetone and Isopropyl Alcohol from Molecular Data. Equilibrium in Dehydrogenation of Isopropyl Alcohol. S. C. Schumann and J. G. Aston. *J. Chem. Phys.* 6. pp. 485-488, Aug., 1938.—The entropy and free energy of acetone and isopropyl alcohol gases have been calculated from the molecular data at several temperatures on the basis of (a) free internal rotation, (b) restricted rotation (with the potentials: Acetone, about C — C bond = 1000 cal.; isopropyl alcohol, about C — C bond = 3400 cal. about C — O = 5000 cal.). The values based on restricted internal rotation were made to be consistent with the third law values. They are in better agreement with the ΔS values from the equilibrium data than those assuming free rotation. AUTHORS.

3786. Entropy of CO. R. Kaischew. *Zeits. f. phys. Chem.* 40. *Abt. B.* 4. pp. 273-280, 1938.—Thermal measurements to determine the entropy of CO do not agree with optical measurements of the same quantity: these latter are about 1.1 Clausius greater than the thermal determinations. Thermal investigations have therefore been made in a special form of vacuum calorimeter designed for determinations at low temperatures. The specific heat was measured through the range from 52° to 75° Abs. No differences were observed when the CO was first cooled down to a temperature below its transformation point — 61.49° Abs.—, or to a temperature between this point and its melting point — 68.10° Abs.—, or not so low as its melting point. The heats of transformation and of fusion were also measured. Possible explanations are offered for the energy difference between the two states of CO at the transition point. These experiments also show the difference of 1.1 Clausius from optical determinations. G. G.

3787. Absolute Rates of Heterogeneous Reactions. Part I. General Theory of Adsorption. G. E. Kimball. *J. Chem. Phys.* 6. pp. 447-453, Aug., 1938.—The statistical theory of reaction rates, developed by Eyring for homogeneous reactions, is extended to include heterogeneous reactions. It is shown that rates of adsorption and desorption are governed by the same form of mathematical expression in terms of partition functions of the system as rates of homogeneous reactions, provided only that for the activated state a "super-partition function," formed by adding together the partition functions for all the active spots, is used. The pseudo-thermodynamical form of the rate constant form is discussed, and illustrated by applications to special cases. AUTHOR.

See also Abstracts 3553, 3564, 3593, 3788, 3809.

VAPORISATION AND CONDENSATION.

***3788. Vapour-Liquid Equilibrium. Part I. Apparatus for Study of Systems with Volatile Components. G. Scatchard, C. L. Raymond and H. H. Gilmann. Part II. Chloroform-Ethanol Mixtures at 35°, 45° and 55° C. G. Scatchard and C. L. Raymond.** *Am. Chem. Soc., J.* 60. pp. 1275-1287, June, 1938.—Part I describes an equilibrium still, embodying a Cottrell pump heated only by the equilibrium vapour, which is designed for studying vapour-liquid equilibria of systems having volatile components. Details are also given of the experimental procedure and subsidiary apparatus used for precision measurements of temperature and pressure. Part II contains experimental results for the vapour and liquid compositions, and the equilibrium pressures for mixtures of chloroform and ethanol at 35°, 45° and 55° C. Deviations from the gas laws are established, and from the results calculations are made of the excess chemical potentials, free energy, heat content and entropy of mixing. Each of the last two passes through a maximum and minimum, and rough experiments show a similar result for the excess heat content of mixing of CCl_4 -ethanol systems. The results are explained in terms of dipole-interactions and molecular bonding. R. W. P.

3789. Vapour Pressure of Propane. P. Harteck and R. Edse. *Zeits. f. phys. Chem.* 182. *Abt.A.* 3. pp. 220-224, 1938.—The vapour pressure of propane contained in a Stock's vapour pressure thermometer is determined over the temperature range -110° to -41° C. by comparison with similar thermometers containing HCl , CO_2 , or NH_3 . The results are tabulated at 1° C. intervals, and, assuming propane to behave as a perfect gas, the heats of vaporisation at -48° and -100° C. are calculated as 4704 ± 7 and 5060 ± 10 cal./gm. respectively. The boiling point at normal atmospheric pressure is given as $-41.14 \pm 0.01^\circ$ C. R. W. P.

3790. Evidence for Validity of Raoult's Law. H. H. Gilmann and P. Gross. *Am. Chem. Soc., J.* 25. pp. 1525-1530, July, 1938.—The total vapour pressures of the systems benzene-diphenyl, benzene-benzyl benzoate and ethyl acetate-benzyl benzoate have been determined from 50 to 95° over limited ranges of concentration. The bearing of these measurements on the validity of Raoult's law as applied to these systems is discussed. The benzene-diphenyl and benzene-benzyl benzoate systems follow Raoult's law within the limits of the experimental error. The ethyl acetate-benzyl benzoate system shows deviations several times larger than the experimental error, indicating a slight, but real, positive deviation from Raoult's law. AUTHORS.

3791. Activity and Osmotic Coefficients of Trivalent Metal Chlorides. C. M. Mason. *Am. Chem. Soc., J.* 60. pp. 1638-1647, July, 1938.—The osmotic coefficients of chlorides of Al, Sc, Y, La, Ce, Pr and Nd have been determined in aqueous solution at 25° by the isotonic method of Robinson and Sinclair [see Abstract 4449 (1934)]. The activity coefficients of these salts are computed from the osmotic coefficients. The data obtained are compared with theory. AUTHOR.

See also Abstract 3553.

ACOUSTICS.

3792. Ultrasonic Radiation Field of a Quartz Disc Radiating into Liquid Media. F. E. Fox and G. D. Rock. *Phys. Rev.* 54. pp. 223-228, Aug. 1, 1938.—The radiation pressure of sound waves on a spherical obstacle is used to determine the distribution of intensity in the sound field of a quartz disc radiating into a liquid medium. The measured distribution of intensity along the axis normal to a crystal face is compared to that to be expected from a plane piston radiating into a semi-infinite medium, and the agreement shows that the theoretical assumptions are fulfilled for the case used and that the "effective area" of the piston is essentially the actual area of the quartz disc. AUTHORS.

3793. Absorption of Supersonic Waves in Electrolytes. P. Bazulin. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 3. pp. 153-156, 1938. *In German.*—The absorption coefficient of supersonic waves in aqueous solutions of a number of common salts is measured. The absorption is proportional to the molecular concentration, and approximately proportional to the square of the frequency. The author also concludes that the absorption increases with the molecular weight and with the valency of the kation. K. M. C.

3794. Break in Register in Singing. W. Trendelenburg. *Preuss. Akad. Wiss. Berlin, Ber.* 1. pp. 5-23, 1938.—The disturbance of voice sounds in singing, caused by artificially added tubes, noted by D. Weiss in 1932, is further investigated. When a series of notes is sung into a long tube of constant length, disturbances are noted at the fundamental frequency of the system: throat-mouth—cavity-tube, and also at the higher partials. When tubes of variable length are used, into which are sung notes of constant vocal-cord frequency, an extensive parallel is shown to exist with the experiments of Vogel on reed pipes with added tubes [see Abstract 1627 (1920)]. G. E. A.

3795. Standing Wave in Water Column Measured by a Broca-Tube. Y. Nisimura and Y. Kohasi. *Tokyo Univ. Aeronaut. Research Inst. Report, No.* 164. [10 pp.], June, 1938.—A long steel pipe filled with water was set vertically on a water reservoir, and near the lower end of the pipe a source of sound was immersed so as to produce a purely sinusoidal wave in the pipe. The standing wave was produced in it between the wave radiated from the source and the wave reflected by the free surface at the upper end of the pipe. The axial distribution of intensity in the pipe was measured by a small Broca-tube connected with a Rayleigh disc. The results show that the form of standing wave is quite different according to the height of the water column in the pipe and is much distorted from a sinusoidal wave but the same pattern of wave is repeated every half wave-length. Owing to the elastic yielding of the wall of the pipe, the velocity of sound obtained from the experiment was smaller than that in free water, and was in close agreement with H. G. Green's calculation. The distortion of the wave is due to the existence of a Broca-tube in the sound field. The problem is solved theoretically and good agreement obtained with experiment. AUTHORS.

See also Abstracts 3455, 3751 and

2837B. Reverberation Measurement. A. Bielusici and O. Roman.

2839B. Acoustical Insulation by Double Partitions of Dissimilar Components. J. E. R. Constable.

2841B. Noise Measurement. P. Huber.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

3796. Mutual Shunt Method of Measuring Self Inductance at Radio Frequencies. A. Campbell. *Phys. Soc., Proc.* 50. pp. 655-660, Sept. 1, 1938.—A simple method of measuring self inductance is described, in which the value is read directly on a mutual inductometer. Its secondary circuit, with an a.c. ammeter in series, is put in parallel with the coil to be tested, the combination being connected, through the primary coil, to an a.c. source of radio frequency giving constant current. The mutual inductance is now varied until the ammeter reads a minimum current, and then the self inductance is equal to the mutual inductance. This result does not involve resistance or frequency. Methods for eliminating the errors due to self and mutual capacitances in the inductometer are indicated.

AUTHOR.

See also Abstract 3871.

CONDUCTION AND DISCHARGE IN GASES.

3797. Conductivity and Dielectric Constant of an Electron Stream. H. E. Hollman and A. Thoma. *Ann. d. Physik*, 32. 5. pp. 459-464, July, 1938.—The authors criticise Benner's equations [see Abstract 1955 (1930)]. From their theory of the inversion of electrons and using Maxwell's equations they deduce expressions for the conductivity and dielectric constant. As the product (frequency $\times$ transit time of electrons) increases from zero, the conductivity follows a damped cyclic curve about zero, and the dielectric constant a similar curve about unity. That is, the conductivity may be negative, and the dielectric constant may be less than one. In the regions in which the dielectric constant tends to pass through zero and become negative plasmoidal oscillations are set up, and the theory no longer holds.

W. H. W.

3798. Explosion Potential in Benzene. E. Badareu and L. Constantinesco. *Comptes Rendus*, 207. pp. 217-220, July 18, 1938.—Explosion potentials furnish valuable information concerning the conditions in a gas and at the surface of the cathode at the moment of the lighting-up of the discharge. The potential is expressed as a function of the product of p , the gas pressure, and d , the distance between the electrodes. The moment of the lighting-up of the discharge is determined by watching for a sudden deviation in a galvanometer placed in circuit with the discharge tube. Experiments were made at pressures from 0.1 to 1.8 mm. Hg. and for values of d between 0.1 and 1.2 cm. Paschen's law was found to be followed strictly. From the experimental curve the values $V_{\min} = (489 \pm 1)$ volt and $p\bar{d}_{\min} = 0.24 \pm 0.01$ mm. Hg. cm. are obtained. These values and also the shape of the curve are compared with those which have been obtained for other gases.

G. G.

3799. Rôle of Tube Walls, and Surface and Space Charges in Electrical Discharges through Rarefied Gases. J. Zeleny. *Frank. Inst., J.* 226. pp. 35-65, July, 1938.—The p.d. between striæ in H_2 are found to be greater in wide than in narrow tubes at pressures above 1.1 mm. The mechanism of the passage of a discharge through a long metal tube with open and gauze-covered ends is discussed and the potential and current distributions are measured. The distribution of the space and surface

charges along a glass discharge tube was found to depend markedly on whether the anode or the kathode was connected to earth. G. C. E.

3800. Gas Temperature and Population of Atomic Levels in a Carbon Arc at Low Pressure. R. C. Mason. *Physica*, 5. pp. 777-784, Aug., 1938. *In English*.—In a carbon arc in air at pressures from 250 mm. to 10 mm. the intensities of the CN 3883 band and of certain lines of Ba and Zn, added in small amount to the anode, have been measured. From the band, the temperature of the gas was determined while from the lines, with the aid of transition probabilities measured at atmospheric pressure, the relative population of several excited states has been found. With decreasing pressure, the gas temperature did not change much, but the density of excited atoms exceeded the density expected in the thermal equilibrium by increasing amounts. It is probable electrons having energies above those corresponding with the energy distribution at the gas temperature are responsible for the increased excitation. AUTHOR.

3801. Critical Potentials of CO. J. Savard. *Soc. Roumaine de Physique, Bull.* 39. 71. pp. 5-10, 1938.—19 critical potentials have been found between 4.75 and 13.2 eV by the electron impact method. The values agree with the minima of the potential curves deduced from spectroscopic data. The results are at variance with the Franck-Condon principle which would exclude many of the experimentally found potentials. G. C. E.

3802. Slow Positive Rays. A. Rostañi. *N. Cimento*, 15. pp. 117-120, Feb., 1938.—The author reviews his own work on this subject [see Abstract 1772 (1937)] and also refers to that of F. Wolf [see Abstract 2806 (1937)]. He comments on the notable difficulties of the quantitative experimental study of the subject, firstly from the nature of the phenomena themselves, and secondly, from the fact that numerous secondary effects are often superposed. Curves are given illustrating the author's own observations on He^+ , Ne^+ and A^+ . One of the most interesting problems set by this general review of the results is that of the maximum of the efficacious sections of neutralisation with finite velocity which are in clear opposition to the theoretical predictions. J. J. S.

***3803. Generation Conditions for Rapid Carriers with H.F. Multiple Acceleration.** E. O. Schlosser. *Ann. d. Physik*, 32. 6. pp. 507-519, July, 1938.—A description is given of the apparatus, including the carrier source, and the properties of the positive carriers furnished by H and Hg are enumerated. By means of a suitable transformer it was found possible to increase the a.c. potential to more than double the applied potential at a frequency of 10^7 . For determining the carrier velocity after multiple h.f. acceleration the method using electric deflection was not found suitable, but the magnetic deflection method proved satisfactory. A tube of the straight type built to give an acceleration equivalent to 200 kV was investigated, the carrier velocities being determined by the magnetic method. On account of discrepancies between the observed wave-lengths and the calculated values a new formula was derived, which gives more accurate values. By varying the accelerating potential it was found possible to obtain both Hg^+ and Hg^{++} carriers. A. W.

See also Abstracts 3644, 3653, 3654, 3655, 3671, 3735, 3736, 3875 and 2602B. Radiation Impulse from a Spark. M. Toepler.

2603B. Electrical Phenomena in the Positive Column at Low Pressure. W. Uytendaele.

CONDUCTION IN SOLIDS AND LIQUIDS.

3804. Effects of Electron Interaction on Energy Levels of Electrons in Metals. E. Wigner. *Faraday Soc., Trans.* 34. pp. 678-685, June, 1938.—The simplest form of the theory of the energy bands in metals which has afforded accurate explanations of often very intricate properties of metals and alloys, considers the metallic electrons as moving (without interacting among themselves) in a pre-existing field with the symmetry given by the space group of the crystal. This picture is now shown to fail in two respects: (1) The field is not preformed, but owes its origin partly to just those electrons whose motion is to be considered; (2) the electrons move independently of each other. The author meets (1) by utilising the Hartree-Fock equations, and has found results which differ significantly from those of the simple theory; (2) requires a consideration of wave functions beyond the Hartree-Fock scheme which will affect the density of the energy levels. The latter is carried out in two steps: (a) The building of wave functions out of the Hartree-Fock solutions which have the proper symmetry, *i.e.* belong to a definite multiplet system. (b) Combination of many wave functions with the same symmetry to obtain a better wave function. Finally the author is led to consider a model corresponding to an "inverted alkali metal." H. H. Ho.

***3805. Thermionic Voltmeter with a Linear Law.** D. G. Reid. *Journ. Sci. Instruments*, 15. pp. 261-263, Aug., 1938.—An a.c. mains operated direct-reading voltmeter is described, the voltage range extending from 0.1 to 1.0 V., higher ranges being available by means of an input divider circuit. Frequency error is negligible up to about 1.5 Mc./sec. The meter is subject to wave-form error. AUTHOR.

3806. Unipolar Conductivity of Carborundum. J. K. Bose and S. R. Khastgir. *Zeits. f. Physik*, 109. 1-2. pp. 80-84, 1938.—By observations with a cathode-ray oscillograph it is shown that the rectifying action of a carborundum crystal clamped between two similar metallic points falls off continuously with increase in the applied a.c. voltage (50 ~). The rectifying action is attributed to a unipolar volume conductivity of the crystal and not to surface (blocking layer) effects. W. S. S.

***3807. Cu₂O Rectifiers.** H. Nöldge. *Phys. Zeits.* 39. pp. 546-559, July 15, 1938.—The production of Cu₂O rectifying plates is described, and curves and calculations are given showing how formation of Cu₂O depends on the temperature, pressure, and oxidation period. The conductivities and rectifying properties of these plates are investigated, and the conclusion is reached that the best rectifiers are obtained by the oxidation of Cu in an annealing furnace at 900° C. and an air pressure of 10-15 mm. for a period of 30 min., followed by tempering for 2 hr. at 450° C. Aquadag is used to form contact between Cu₂O and the electrode, and improved rectification is obtained if the unit is finally submitted to a pressure of 300 to 500 kg/cm². The paper contains a Bibliography of 125 papers dealing with the construction and properties of Cu₂O photo-cells and allied subjects. R. W. P.

3808. "Overshoot Phenomenon" in Supraconductivity. A. D. Misener. *Cambridge Phil. Soc., Proc.* 34. pp. 465-469, July, 1938.—In a previous paper [see Abstract 5074 (1937)] experiments were described in which the "overshoot phenomenon" reported by Silsbee, Scott and Brickwedde might have been expected but was not observed. Silsbee has pointed out that the current densities used by Misener were appreciably

smaller than the values he had found necessary to initiate "overshoots." Experiments using considerably higher current densities were therefore carried out. Again no evidence of "overshoots" was obtained. A sample of the Ta used by Silsbee, Scott and Brickwedde was specially investigated. Its high resistance ratio and lower than normal temperature for superconduction appear to indicate a lack of purity and it is concluded that the difference in behaviour of this sample and that used by Misener is due to difference in purity. From the fact that the continued unsteadiness of resistance observed with a straight specimen and the "overshoots" obtained with coiled specimens of the same material occur at similar regions of the transition curve, it is concluded that they are due to the same cause. This effect has been observed in specimens of simple shape only when of relatively impure material. With purer substances it has been observed only at excessively high current densities and with specimens of complicated shape. It has not been found with purer specimens of simple shape and hence seems to be a secondary effect in the transition from the superconducting to the nonsuperconducting state. A. W.

3809. Electrical Conductivity and Phase Diagram of Ni-Mo Alloys. G. Grube and H. Schlecht. *Zeits. f. Elektrochem.* 44. pp. 413-422, July, 1938.—The dependence of electrical conductivity upon temperature is investigated for alloys of the system Ni-Mo. The data obtained, augmented by the results of X-ray and microscopic examination and tests of hardness and corrosion, are embodied in a phase diagram. The diagram is incomplete, however, since the methods employed cannot detect one phase whose existence is proved by magnetic investigations to be described in a later paper. L. A. W.

3810. Electrolytic Conduction in Solids and Crystal Structure. J. A. A. Ketelaar. *Faraday Soc., Trans.* 34. pp. 874-882; *Disc.*, 882, Aug., 1938.—The mechanism of conduction in the good ionic conductors is discussed. The case of Ag_2HgI_4 is discussed in detail in connection with the theory of Bragg and Williams on order-disorder transformations. The dependence of the energy difference V from the degree of order S , i.e., the influence of the cooperation, is derived experimentally. Attention is drawn to the difference between true averaged structures and multiple twin structures. AUTHOR.

3811. Conductance of Aqueous Solutions of Electrolytes. D. A. MacInnes. *Frank. Inst., J.* 225. pp. 661-686, June, 1938.—Since the Debye-Hückel theory clearly indicates, from thermodynamic considerations, that strong electrolytes are substantially completely dissociated in aqueous solutions, it has been necessary to replace, in the explanation of the conductances of such electrolytes, the Arrhenius theory, which assumes partial dissociation and constant ion mobilities, with a theory which provides for changing mobilities with increasing ion concentrations. To this end Debye and Hückel, and Onsager, suggest two mechanisms: the "electrophoretic effect" and "the time of relaxation effect," both dependent upon interionic electrostatic attractions and repulsions. Experimental tests of Onsager's relations show that his equations account accurately, at least for very dilute solutions, for the changes with concentration of the conductances of solutions of electrolytes containing ions of widely differing mobilities and valencies. For higher concentrations semi-empirical equations are available. In contrast to the Arrhenius theory, the newer ideas call for changes in the transference numbers with the concentration, which have been found experimentally.

Precision transference measurements have also furnished an experimental test of Kohlrausch's law of independent mobilities of ions. The theory of interionic attractions and repulsions is, in addition, of utility in dealing with the ionic part of solutions of weak electrolytes. By computing degrees of dissociation in a manner which allows for changing ion mobilities a test is obtained of the Debye-Hückel limiting relation connecting activity coefficients with ion concentrations.

AUTHOR.

3812. Limiting Conductivities of Organic Acids in Aqueous Solutions. J. F. J. Dippy. *Phil. Mag.* 26. pp. 93-98, July, 1938.—Working on the assumption that Onsager's equation holds for dilute aqueous solutions of Na salts of organic acids the author has employed a method of determining, with reasonable accuracy, the equivalent conductivity at infinite dilution which eliminates the necessity of making the modified solvent correction appertaining to salts undergoing partial hydrolysis. The procedure is justified in view of the agreement with determinations of other workers employing the more laborious calculations. Data are given for the Na salts of acrylic, vinylacetic, and allylacetic acids.

H. H. Ho.

3813. Laws of Conduction in Semiconductors. F. Möglich. *Zeits. f. Physik*, 109. 7-8. pp. 503-509, 1938.—An internal ionisation effect is postulated to account for the phenomena of conduction in semiconductors. With the aid of the formula due to Saha, it is shown that two quite distinct laws of conduction are obtained, depending on whether the work of dissociation is large or small; these are borne out by experimental results.

H. J. H. S.

3814. Electrical Conductivity and Thermoelectric Characteristic of Semiconductors. B. M. Hochberg and M. S. Sominski. *Phys. Zeits. d. Sowjetunion*, 13. 2. pp. 198-223, 1938. *In German*.—The thermoelectric power of the network Cu-semiconductor-Cu was investigated for WO_3 , V_2O_5 , CuO, Se, MoS_2 , SiC, Bi_2S_3 , Tl_2S , as well as for cobalt oxide. For most of these semiconductors parallel measurements of the thermoe.m.f. and the electrical conductivity in dependence on temperature were carried out. In the case of Tl_2S the thermo-e.m.f. changes its sign depending on the concentration of the mixtures and the temperature. The results obtained are discussed in relation to the views on the diffusion of electrons and on positive "holes."

J. J. S.

***3815. Galvanometer Giving Logarithmic Readings.** Y. le Grand. *Comptes Rendus*, 207. pp. 50-51, July 4, 1938.—Superposed on the current to be measured is one of opposite direction the intensity of which increases with the deviation of the galvanometer. This is effected by illuminating a suitable photo-cell with a beam of light reflected from the mirror of the galvanometer, a screen and diaphragm being so placed on its course as to modify its intensity suitably according to the movement of the mirror. The devices are figured.

C. A. S.

See also Abstracts 3468, 3759, 3860, 3878 and 2626B. Measurement of the Specific Resistance of Liquids. A. Claassen.

DIELECTRICS AND CAPACITANCE.

3816. Calculation of Polarisability of a Molecule. M. M. Biedermann. *Physica*, 5. pp. 689-692, Aug., 1938. *In English*.—A wave-mechanical discussion of the theory of Silberstein [see Abstract 772 (1917)] on polarisation of molecules is given. It is shown, that the additional polarisation of one atom by the electric dipole induced in another,

can be described by using the perturbed wave function in the second-order approximation.

AUTHOR.

3817. Dielectric Constants of Fluorine Compounds. R. M. Fuoss. *Am. Chem. Soc., J.* 60. pp. 1633-1637, July, 1938.—The total polarisation of a series of F compounds has been determined by Schering bridge measurements on the gases. By making reasonable assumptions concerning the electronic and atomic polarisations, values for their dipole moments were obtained as follows: CF_4 , 0.0; CF_3Cl , 0.47; CF_2Cl_2 , 0.55; CFCl_3 , 0.53; CHF_2Cl , 1.41; CHFC_2Cl , 1.34; CHF_2Br , 1.30; CF_2Br_2 , 0.72; CF_3CF_3 , 0.0; $\text{CClF}_2\text{CClF}_2$, 0.0; CH_3CF_3 , 2.27; CH_3CClF_2 , 2.13; $\text{CF}_3\text{CF}_2\text{Cl}$, 0.14; $\text{CF}_3\text{CH}_2\text{Cl}$, 1.64. These figures are in agreement with the theory of induction between dipole moments.

AUTHOR.

3818. Electric Moments of Methyl and Ethyl Alcohols. J. D. Stranathan. *J. Chem. Phys.* 6. pp. 395-398, July, 1938.—The dielectric constant of MeOH vapour has been determined by the heterodyne beat method of 14 temperatures between 25° and 206° ; at each temperature measurements were made at an average of 23 pressures, ranging from approximately zero to almost saturation. The measured moment of MeOH is $1.706 \pm 0.005 D$. By taking the sum of the electronic and atomic polarisations as 8.6 a moment of $1.688 \pm 0.006 D$ is obtained. The mean $(1.698 \pm 0.005) D$ is given as the most probable value. The data of Knowles [see Abstract 357 (1933)] on EtOH vapour have been recalculated by the method used for MeOH. The most probable moment of EtOH is $1.702 \pm 0.007 D$. [See Abstract 5077 (1937).] W. R. A.

3819. Electric Moments of NO_2 and N_2O_4 Molecules. R. W. Schulz. *Zeits. f. Physik*, 109. 7-8. pp. 517-537, 1938.—From measurements of the dielectric constants of mixtures of NO_2 and N_2O_4 at temperatures from 52° to 90°C . and at pressures of 200 to 562 mm. Hg, the electric moments of the NO_2 and N_2O_4 molecules are calculated to be 0.29×10^{-18} and 0.37×10^{-18} respectively. The electric moment of the NO_2 molecule is not found to vary with temperature, as reported by Williams, Schwingel and Winning [see Abstract 1815 (1936)]. E. R.

3820. Series Effect on Dipole Moments of Alkyl Halides in Solution. E. G. Cowley and J. R. Partington. *Chem. Soc., J.* pp. 977-983, July, 1938.—The effects of induction in the polar molecule and in the solvent by the principal dipole of various alkyl halides have been examined and a comparison has been made between the theoretical predictions and the experimental moments, measured in benzene at 20° . It has been found that the moments of the compounds increase as the series of n -alkyl iodides and bromides are ascended, and that the effect is greater in the former series. This is probably due to differences in properties between the polar groups.

AUTHORS.

3821. Dielectric Properties of Carbohaemoglobins. S. Arrhenius. *Phys. Zeits.* 39. pp. 559-564, July 15, 1938.—From measurements of the dielectric properties of carbohaemoglobin solutions at wave-lengths from 92 to 1870 m., the relaxation times and dipole moments of the molecules are estimated. E. R.

3822. New Electrical Phenomenon. G. Piccardi. *Gazz. Chim. Ital.* 68. pp. 246-263, April, 1938.—A polarised dielectric by simple contact with water and other liquids with permanent dipolar moment, produces modifications of a non-elastic or non-completely-elastic nature, in the sense that they persist for some time after removal of the dielectric.

A modification "T" is obtained by means of (1) an electric field at an isolated armature, (2) an electrostatic machine immersed in the mass of liquid, (3) polarisation with Hg; and a modification "R" by arranging an apparatus in the form of a condenser with water electrodes and glass dielectric. The chemical and biological properties of these two varieties differ, and the possible effect on living organisms is discussed. In contact with a metallic spiral containing refrigerant, immersed in either modification, the "R" becomes "T" and the "T" becomes "R". The work is being continued.

D. R. H.

See also Abstracts 3797, 3871.

ELECTROCHEMISTRY.

3823. Glow-Discharge Electrolysis. Part VII. A. Klemenc and H. Kalisch. *Zeits. f. phys. Chem.* 182. *Abt. A.* 2. pp. 91-102, 1938.—Continuing previous work [see Abstract 3237 (1937)] the authors find that glow-discharge electrolysis, like ordinary electrolysis, is influenced by the presence of small concentrations of certain substances. Thus for instance in the oxidation of $2N$ H_2SO_4 by glow-discharge electrolysis the yield is appreciably reduced by the presence of HCl at a concentration of only $10^{-3} N$. This indicates that the oxidation of the H_2SO_4 takes place in the liquid phase. The presence of HCl at a concentration of $2 \cdot 10^{-2} N$ in the $2N$ H_2SO_4 lowers the anode fall by 23 V and the kathode fall by 11 V. [See following Abstract.]

L. A. W.

3824. Glow-Discharge Electrolysis. Part VIII. A. Klemenc and H. Milleret. *Zeits. f. phys. Chem.* 40. *Abt. B.* 4. pp. 252-262, 1938.—The kathode and anode falls over certain electrolytes during glow-discharge electrolysis are measured by means of a probe electrode. The potential distribution in the discharge over $2N$ H_2SO_4 is investigated in detail. The conditions in the gas phase are found to be similar to those in a discharge with a metal electrode in place of the electrolyte. [See preceding Abstract.]

L. A. W.

3825. Movement of Ions and Electrons in Solids and the Interpretation of Reactions between Solids. C. Wagner. *Faraday Soc., Trans.* 34. pp. 851-859; *Disc.*, 859-860, Aug., 1938.—The movement of ions and electrons in solids is discussed and the work of other investigators in this field is reviewed. Movement of ions and electrons in solid ionic compounds is considered possible, and some typical cases are described qualitatively. The degree of disorder in AgCl can be calculated from the electrical conductivities of pure AgCl and of solutions containing $CdCl_2$ or $PbCl_2$ in AgCl. It is considered that diffusion processes are required in reactions between solids, the diffusion taking place in the layers of the reaction products. [See Abstract 3461 (1938).]

F. J. B.

3826. Polished Electrodes and the Beilby Layer-Electrolyte Passage Zone. F. J. Taboury. *Comptes Rendus*, 206. pp. 1953-1955, June 27, 1938.—The limits within which the analogy between the Beilby layer-electrolyte passage zone and a small condenser shunted by a high resistance holds are further investigated, and the analogy shown to hold only for small p.d. and a large surface. [See Abstract 2788 (1937).]

C. A. S.

***3827. Glass Electrode for Differential Titrations. M. Paić.** *Comptes Rendus*, 207. pp. 151-153, July 11, 1938.—The glass electrode described consists of a U-tube divided into two compartments by a very thin glass membrane, on opposite sides of which are placed the solutions

which are to be titrated by the differential method. The p.d. between the two sides of the glass membrane is determined. A. J. M.

3828. Anodic Oxidation of Acid-Ester Salts. A. Hickling and J. V. Westwood. *Chem. Soc., J.* pp. 1039-1046, July, 1938.—A complete qualitative and quantitative study of the electrolytic oxidation of potassium ethyl malonate in aqueous solution has been made, and the effect of such variable factors as current density, concentration, acidity, temperature, anode material, presence of foreign kations and anions, and electrode potential on the current efficiency for the formation of ethyl succinate has been investigated. Possible anodic mechanisms are discussed, and it is concluded that none of the views previously advanced will account for the phenomena observed. A new theory, involving the intermediate formation of H_2O_2 at the anode, is put forward. AUTHORS.

3829. Normal Volta Potentials $\Delta\psi_0$ of Two-Phase Systems. O. Klein and E. Lange. *Zeits. f. Elektrochem.* 44. pp. 562-568, Aug., 1938.—This paper records a continuation of previous work [see Abstract 4180 (1937)] on Volta potentials in electro-chemical two-phase systems, and deals in particular with recent determinations of normal Volta potentials $\Delta\psi_0$ and with the concentration and time-dependence of the surface potentials, χ , in highly concentrated solutions of electrolytes. The real heats of hydration are given for the alkali- and halogen-ions. The indirectly derived $\Delta\psi_0$ values were tested by direct experimental determinations from the solution systems Cu/Cu^{++} , Zn/Zn^{++} , and Ag/Ag^+ . The paper concludes with a general discussion of the temporary changes which occur in the fine structure of solution surfaces; graphical illustrations are included. A picture is developed of transition from a fresh to a more matured surface condition. H. H. Ho.

3830. Electrochemical Interpretation of Wagner's Theory of Tarnishing Reactions. T. P. Hoar and L. E. Price. *Faraday Soc., Trans.* 34. pp. 867-872; *Disc.*, 872-874, Aug., 1938.—A metallic surface undergoing oxidation or tarnishing, with the production of a compact surface film of oxide, sulphide, etc., is regarded as a current-producing cell with the metal/film and the film/attacking substance interfaces as anode and kathode respectively, the film being both electrolyte and external circuit (since it has both ionic and electronic conductivities). An expression for the rate of tarnishing, similar to that originally obtained at some length by Wagner utilising the chemical potential function, is simply deduced. The similar expression for the more complicated case where the tarnish-film conductivity varies with the pressure of the attacking gas is also obtained electrochemically. The application of the theory to the explanation of tarnish-resistant metals and alloys is pointed out. AUTHORS.

See also Abstracts 3439, 3461, 3489, 3791, 3852 and

2595B. Optical Study of Negative Plate of Planté Accumulator in Operation. G. Valenti.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

3831. Production of Heavy Electrons. L. W. Nordheim and G. Nordheim. *Phys. Rev.* 54. pp. 254-265, Aug. 15, 1938.—The barytron theory of nuclear forces shows a close correspondence to the theory of the electromagnetic field. Estimates based on this analogy are given for the probabilities of the processes leading to actual production of barytrons. A comparison with the experimental evidence regarding the occurrence of
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barytrons in the cosmic radiation shows that the theoretical cross-sections are too small to explain the properties of the hard component. The difficulty is increased by the short lifetime of the barytrons which is estimated to be of the order $\sim 10^{-8}$ sec. from radiative β -decay. Therefore no simple picture of barytron production in terms similar to radiation theory can be given. This failure, however, indicates only the inapplicability of perturbation calculations, but does not constitute an actual disproof of the link between nuclear forces and cosmic radiation. **AUTHORS.**

3832. Most Probable Value of the Electronic Charge and other Related Constants for 1938. R. A. Millikan. *Ann. d. Physik*, 32. 6. p. 520, July, 1938.—Corrections. [See Abstract 2997 (1938).]

3833. Neutron Production through D Canal Rays. W. de Groot and F. M. Penning. *Physica*, 5. pp. 512–520, June, 1938. *In German*.—From the yield of the neutrons produced by D-ions impinging upon targets of D_3PO_4 , Li, Be, C as measured by Amaldi, Hafstad and Tuve, the effective cross-sections for D, Li, Be and C as a function of the velocity v of the projectile are derived, using Mano's data for the range of charged particles in air and for the atomic stopping power of the elements. The yields as found by the authors named are extrapolated to lower energies. **J. J. S.**

3834. Formation of Deuterons by Proton Combination. H. A. Bethe and C. L. Critchfield. *Phys. Rev.* 54. pp. 248–254, Aug. 15, 1938.—The probability of the astrophysically important reaction $H + H = D + e^+$ is calculated. For the probability of positron emission, Fermi's theory is used. The penetration of the protons through their mutual potential barrier, and the transition probability to the deuteron state, can be calculated exactly, using the known interaction between two protons. The energy evolution due to the reaction is about 2 ergs/gm./sec. under the conditions prevailing at the centre of the sun (density 80, H content 35% by weight, temperature 2×10^7 degrees). This is almost but not quite sufficient to explain the observed average energy evolution of the sun (2 ergs/gm./sec.) because only a small part of the sun has high temperature and density. The reaction rate depends on the temperature approximately as $T^{3.5}$ for temperatures around 2×10^7 degrees. **AUTHORS.**

3835. Energy Loss of Fast Electrons by Radiation. L. A. Arcimovič and V. A. Chramov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 7. pp. 415–417, 1938. *In English*.—A longitudinal magnetic field is used to focus the β -rays of energy 2 eMV from Rn and examination is made of the production of γ -rays when these electrons impinge on solid targets. Using C, Al, Cu, Sn and Pb as the bombarded elements and a counter at 50° to the incident beam the intensity of the γ -rays emitted is found to be proportional to Z . This behaviour is in qualitative agreement with the theory of Bethe and Heitler. The variation of intensity of the γ -rays for incident electrons of energies ranging from 0.67 to 3 eMV was also found to be in agreement with the theory, the latter predicting 2.9% for the radiation loss in Cu at 2.2 eMV, the observed value being $2.8 \pm 0.6\%$. **F. C. C.**

***3836. Transmission of Slow Electrons through Thin Collodion Films.** M. Ference and R. J. Stephenson. *Rev. Sci. Instruments*, 9. pp. 246–248, Aug., 1938.—An apparatus is described for determining the transmission of slow electrons through thin collodion films. The range in accelerating voltages used was from 800 to 34,000 eV and the film thicknesses from 10^{-3} to 7×10^{-6} cm. **AUTHORS.**

3837. Photographic Intensity-Measurements of Electron Diffraction Patterns. L. S. Ornstein, H. Brinkman, A. Hauer and T. Tol. *Physica*, 5. pp. 693-700, Aug., 1938. *In English*.—A photographic method for the measurements of electron diffraction patterns is developed and applied to the study of Cu and Ag films. The atomic factor electron diffraction shows a dependence on the angle of scattering different from the dependence found by previous investigators. **AUTHORS.**

3838. Secondary Emission of Beryllium. E. G. Schneider. *Phys. Rev.* 54. pp. 185-188, Aug. 1, 1938.—The secondary electron emission of Be films prepared by evaporation in a high vacuum has been studied. As the Be is deposited the secondary emission ratio (defined as the ratio of the number of electrons leaving the surface, to the number of primary electrons impinging on it) rises from that of the support metal to a value in the neighbourhood of 2.5. The position of the maximum with respect to energy of primary electrons remains near that of the support metal. As the thickness of the layer is increased the ratio falls to less than unity and the voltage of the primary electrons necessary to reach the maximum drops to about 200 V. Heating the thick Be layer to a bright red for a few minutes raises the emission to about 1.6 with the maximum at a primary energy of about 630 V. Oxidation of the surface increases the emission to about 4.1. Explanations of these effects are discussed and arguments are presented favouring the acceptance of the value of 1.6 as the maximum secondary emission ratio to be expected for pure bulk Be. **AUTHOR.**

3839. Secondary-Electron Emission from Ni, Co and Fe as a Function of Temperature. L. R. G. Treloar and D. H. Landon. *Phys. Soc., Proc.* 50. pp. 625-634, Sept. 1, 1938.—The evidence of other workers to the effect that the magnetic and structural changes which occur in ferromagnetic metals are accompanied by changes in the secondary-electron emission is critically discussed, and it is shown that this evidence is in many respects unsatisfactory. The authors have measured the secondary-emission coefficients for Ni, Co and Fe at various primary voltages over a temperature range of about 400° C., and find in all cases either no change or a slight and gradual fall in the coefficient with rising temperature, the latter effect probably being due to surface gas. No evidence was obtained of any discontinuous changes in secondary emission at the transformation points, though a change of less than 5% could readily have been detected. **AUTHORS.**

3840. Diffraction of Electrons by Oxide-Coated Kathodes. J. A. Darbyshire. *Phys. Soc., Proc.* 50. pp. 635-641, Sept. 1, 1938.—Electron-diffraction methods have been used to examine the surfaces of thermionic oxide-coated kathodes. The Ni kathodes were coated with a paste containing a solid solution of BaCO₃ and SrCO₃, and the diffraction camera was fitted up with ovens so that getter pellets could be fired off at suitable stages during the activation. These kathodes, after activation by heat treatment to give good emission, gave patterns of SrO alone when no getter had been fired off, but gave patterns of MgO along with SrO when the getter pellet (Ba-Mg alloy) had been fired off during the activation. Kathodes consisting of BaCO₃ alone before activation gave patterns of BaO after activation, whereas kathodes consisting of SrCO₃ gave patterns of SrO after activation. **AUTHOR.**

3841. Path of Electrons Through an Electrical Cylindrical Lens. W. Gaedcke. *Zeits. f. techn. Physik*, 19. 7. pp. 204-206, 1938.—An electron-optical analogue of a cylindrical lens is described in which

there is a kathode of thoriated W wire 0.08 mm. dia. and 2 cm. long, an auxiliary screen and an anode assembly containing a slit. Curves are shown to illustrate the effect on the anode current of the anode voltage and of the kathode-screen distance for a constant radius of curvature of the auxiliary screen. The effect on the electron distribution on the screen of varying the auxiliary screen voltage with a constant anode voltage is also described.

H. J. H. S.

See also Abstracts 3532, 3643, 3646, 3735, 3736, 3804, 3880.

ELECTROSTATICS.

***3842. Powerful H.V. Generator.** A. Raskin. *Comptes Rendus*, 206. pp. 1884-1885, June 20, 1938.—Certain mechanical, electrical and aerodynamic improvements in the design of a dust h.v. generator have raised the output to 500 mA at 400,000 V.

G. C. E.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

3843. Magneto-Resistance Change of Ferromagnetics in Alternating Magnetic Field. S. Sharan. *Indian Journ. Phys.* 12. pp. 203-210, May, 1938.—The resistances of Ni and Ni-Fe permalloy were studied under the effect of an alternating magnetic field alone and also under the effect of an alternating and a direct magnetic field simultaneously. It was observed that the application of a gradually increasing alternating field in the absence of a direct field produces no change in the resistance of the specimen, until it has a value equal to the coercive field of the specimen; and if the alternating field is increased beyond this value the resistance increases in the same way as it does in the case of the direct field. In the presence of a direct field, the alternating field first causes a decrease in the resistance and after a certain value has been reached, corresponding to which the resistance is minimum, the resistance begins to increase as usual. A definite relation was observed between this particular value of the alternating field and the direct field. Further, it was observed that the resistance of the specimen increases beyond its original value at zero alternating field, only when the alternating field is greater than the sum of the direct field and the coercive field of the specimen. Theoretical explanation of the above observations is given.

AUTHOR.

MAGNETISM AND ELECTROMAGNETISM.

3844. Domain Theory of Ferromagnetics Under Stress. Part III. W. F. Brown, Jr. *Phys. Rev.* 54. pp. 279-287, Aug. 15, 1938.—It is shown that the statistical theory of Parts I and II [see Abstract 2166 (1938)] can be extended so as to give formulæ for the magnetisation curve and other properties of an ideal reversible specimen, over the range of field values in which magnetisation proceeds by a displacement of the boundaries between domains. The application to actual specimens is made by assuming that the reversible properties of an actual specimen are identical with the properties, at the same magnetisation, of an ideal specimen having the same initial susceptibility. This leads to a formula for the reversible susceptibility of Ni and Fe that was originally suggested by Gans and verified by him experimentally, but for which it

is believed no satisfactory derivation has hitherto been offered. In the case of one Ni specimen and of Co, where the data do not follow the Gans curve, formulæ agreeing better with experiment are obtained by taking account of the anisotropy of the domains. Reasons are given for believing that the replacement of variable by fixed domain volumes, an arbitrary step taken in order to simplify the problem, is probably not essential to the result.

AUTHOR.

3845. Magnetic Anisotropy in Ferromagnetic Crystals in Weak Fields. E. Kondorsky. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 6. pp. 325–327, 1938. *In English.*—The conclusions arrived at by Akulov and Bozorth to account for the magnetic anisotropy of ferromagnetics in weak fields contain assumptions concerning the initial state of the crystal before magnetisation. These are briefly examined from the viewpoint of the model of the process of weak field magnetisation due to Sixtus and Tonks and others and it is suggested that measurements of the reversible susceptibility of the crystals would be of value. H. J. H. S.

3846. Magnetic Properties of Ferric Hydroxide. R. Chevallier and S. Mathieu. *Comptes Rendus*, 206. pp. 1955–1958, June 27, and 207. pp. 58–61, July 4, 1938.—The spontaneous transition of moist ferric hydroxide to either $\alpha\text{-Fe}_2\text{O}_3$ or to goethite ($\alpha\text{-Fe}_2\text{O}_3\cdot\text{H}_2\text{O}$), I, has been studied by magnetic measurements at various times after precipitation and with variations in the concentrations of the $\text{Fe}^{\cdots}$ and OH' ions. For the first two hours the susceptibility increases regularly; thereafter a more rapid increase with time takes place until a maximum value is attained at about 20 to 30 hr.; a decrease then takes place. The total susceptibility (χ) is the sum of the initial susceptibility (χ_0) and a susceptibility variable with time (χ_1). Variation of $[\text{Fe}^{\cdots}]$ or $[\text{OH}']$ has little effect on χ_0 . χ_1 , however, is considerably influenced by $[\text{OH}']$ but uninfluenced by $[\text{Fe}^{\cdots}]$. A relationship between the magnetic properties of moist- and dry ferric hydroxides of equal age and at identical OH' concentrations has been found. Ferric hydroxide formed in alkaline media contains (I), which can be isolated by nitric acid, and a ferric hydroxide insoluble in nitric acid (II). The individual contributions of (I) and (II) are considered. The susceptibility of (I) is small, whilst that of (II) is high and increases with time. The high value for (II) may arise from the presence of some ferromagnetic ferric oxide formed during the precipitation of the ferric hydroxide; this theory has not yet been probed but evidence of the heterogeneity of (II) is cited in its favour.

W. R. A.

3847. Magnetic Susceptibility and Phase Diagram of Ni-Mo Alloys. G. Grube and O. Winkler. *Zeits. f. Elektrochem.* 44. pp. 423–428, July, 1938.—Temperature-susceptibility curves are given for alloys of the Ni-Mo system ranging from pure Ni to pure Mo over the temperature interval 0–1400° C. The phase diagram of the system is deduced from the discontinuities in these curves, aided by X-ray data. Isotherms of specific susceptibility of the alloys at 800, 900 and 1000° C. show, in the same way as the isotherms of electrical conductivity, a linear path in the heterogeneous state and a progressive curve in the homogeneous state whilst the phase limits in the constitution diagram appear as changes in direction of the isothermals. [See Abstract 376 (1937).] H. J. H. S.

3848. Change of Thermal Energy with Adiabatic Change of Magnetisation in Iron, Nickel and Carbon Steel. T. C. Hardy and S. L. Quimby. *Phys. Rev.* 54. pp. 217–223, Aug. 1, 1938.—Previous

methods for measuring the change in thermal energy which occurs when the magnetisation of a ferromagnetic material is altered adiabatically have been so improved as to permit a precise study of this phenomenon in magnetically soft materials. The materials here dealt with are carbon steel, and annealed and unannealed Armco iron and nickel. The change in thermal energy of each of these substances is traced through a complete half-cycle of magnetisation which starts with the maximum value of the intensity of magnetisation. The external work done by the specimen at each stage of the process is likewise evaluated. The decrease in thermal energy on demagnetisation is less than the external work done by the specimen in iron and steel, while in unannealed nickel it is greater. In annealed nickel the decrease in thermal energy is greater than the external work when the magnetisation process is continuous and less when it is discontinuous. AUTHORS.

3849. Magnetic Viscosity in Iron. C. W. Heaps. *Phys. Rev.* 54. pp. 288-293, Aug. 15, 1938.—Magnetic viscosity—the change of induction occurring after the magnetising field has ceased to vary—has been measured in a bar of commercial iron, with a measuring circuit designed to eliminate spurious effects arising from sparking at switches. Magnetic viscosity is found to depend on previous magnetic states, in agreement with observations of Mitkevitch and contrary to Preisach's results. It appears, therefore, as if reversible domains could retain their lagging propensity while the magnetic force is varying over a considerable range. The viscous effect is found to depend on the magnitude of the previous change of induction if the latter is small, but is independent of this change if it is greater than 60 gauss. In small, subsidiary hysteresis loops, such as are used in determining reversible permeability, it is found that the Barkhausen effect is not present although there is hysteresis and magnetic viscosity. It is therefore concluded that the movement of the boundaries of saturated domains in the material is subject to time-lag. AUTHOR.

3850. Magnetic Behaviour of Diamagnetic Salts at Lattice Change Points. G. E. R. Schulze. *Zeits. f. phys. Chem.* 40. Abt. B. 4. pp. 308-318, 1938.—The change in susceptibility of NH_4Br , NH_4NO_3 , KNO_3 , TiNO_3 , AgI , and Ag_2S is investigated by the method of Curie and Chéneveau [see Abstract 1762 (1910)] of balancing the force set up when the specimen is placed in a non-uniform magnetic field. The corrections to be applied are discussed. In no case does susceptibility alter by more than 4%, while in the case of BaSO_4 in which anisotropy of the crystal units is not specially marked, the alteration is about 10%. It appears therefore that the observed change can easily be explained by the alteration in atomic arrangement, without assuming any change in the state of the atoms themselves. On the other hand in the transfer from diamond to graphite (-0.495×10^{-6} to -3.0×10^{-6}) and from grey to white tin (-0.25×10^{-6} to $+0.026 \times 10^{-6}$), in which the electron configurations are most certainly altered, the change in susceptibility is quite marked. D. R. H.

3851. Accurate Measurements of Magnetic Susceptibilities of Rare Earths by the Faraday Method. B. Cabrera. *J. de Physique et le Radium*, 9. pp. 209-227, June, 1938.—Examination of certain rare-earth salts by the Faraday method, with special precautions which are discussed, leads to the conclusion that the Weiss whole number law agrees with experimental data better than the values obtained from the theory of Hund and van Vleck. W. R. A.

3852. Potentiometric and Magnetometric Study of the Duroquinone System. L. Michaelis, M. P. Schubert, R. K. Reber, J. A. Kuck and S. Granick. *Am. Chem. Soc., J.* 60. pp. 1678-1683, July, 1938.—Duroquinone in a strongly alkaline solution forms a free paramagnetic semiquinone radical of brown colour as intermediate step of the reduction. There is no dimeric form of this radical; in other words, no compound corresponding to the ordinary crystalline benzoquinhydrone, which is a dimeric diamagnetic molecule, is formed from duroquinone and durohydroquinone either from alkaline or acid solutions. Solid benzoquinhydrone is a compound formed from quinone and hydroquinone by two hydrogen bonds. These bonds cannot be formed in duroquinone due to steric hindrance. The maximum percentage of the duro-semiquinone radical in equilibrium with its parent substances continuously increases with increasing pH. At pH 13 this maximum is about 50%, a result which is the same whether derived from potentiometric or magnetic observations. AUTHORS.

3853. Magnetic Susceptibilities of Inorganic Complex Compounds. J. H. Frazer and N. O. Long. *J. Chem. Phys.* 6. pp. 462-465, Aug., 1938.—A standard method used in the determination of the gyro-magnetic effect has been so modified as to permit the determination of magnetic susceptibilities. Its use is suggested for the determination of the susceptibilities of complex compounds, since it utilises weak fields, and also requires only a small amount (less than 0.5 gm.) of the material to be tested. The susceptibilities of some compounds containing NO have been measured. AUTHORS.

3854. Paramagnetic Relaxation in Iron Ammonium Alum at Low Temperatures. W. J. de Haas and F. K. du Pré. *K. Onnes Lab., Leiden, Comm. No. 253a. Physica*, 5. pp. 501-506, June, 1938. *In English.*—By adiabatic demagnetisation of certain paramagnetic salts extremely low temperatures can be obtained. The question arises whether these low temperatures must be ascribed only to the spin system or whether they also hold for the crystal lattice. It is possible that the temperature equilibrium between spins and lattice establishes itself so slowly that in the time available for the experiments this equilibrium is not reached. That this occurs is the view of Heitler and Teller from their calculation of the relaxation time, T , for this equilibrium. Even at 1° K. in a magnetic field of 2000 gauss T is of the order of 100 sec. for the usual substances. The authors of the present paper conclude from their experiments that the relaxation time T of the spin-lattice equilibrium is substantially smaller than the Heitler-Teller value. They find at 1.22° K. in a longitudinal field of 2000 gauss a considerable dependence of χ' , the thermal value of the susceptibility, on the frequency at about 15~. As to the transverse effect the relaxation time will be substantially smaller for in that case the interaction between spins and lattice does not play an important part. [See following Abstract.] J. J. S.

3855. Thermodynamic Interpretation of Paramagnetic Relaxation Phenomena. H. B. G. Casimir and F. K. du Pré. *K. Onnes Lab., Leiden. Comm. Suppl. No. 85a. Physica*, 5. pp. 507-511, June, 1938.—*In English.*—Referring to the paper on paramagnetic relaxation [see preceding Abstract] the authors in the present paper endeavour to arrive at a quantitative understanding of the results, and they derive a definite value for the time constant of the spin-lattice equilibrium. The result

confirms the conclusion previously reached that Heitler and Teller's estimate gives an incorrect order of magnitude. J. J. S.

3856. Paramagnetism of the Ferromagnetic Elements. W. Sucksmith and R. R. Pearce. *Roy. Soc., Proc.* 167A. pp. 189-204, Aug. 5, 1938.—A method is described for measuring magnetic susceptibilities in a controlled atmosphere or *in vacuo* at temperatures up to 1500° C. The special precautions required to prevent solid diffusion and minimise evaporation in measurements on metals are discussed. Accurate measurements on the susceptibilities of the ferromagnetic elements, hitherto confined to nickel, are extended to Co and Fe. The magneton numbers for both these elements are deduced to an estimated accuracy of 1-2% from the experimental data. It is shown that the existing theory is inadequate to explain the new results obtained. AUTHORS.

3857. Principal Paramagnetic Susceptibilities of Potassium Ferricyanide at Low Temperatures. L. C. Jackson. *Phys. Soc., Proc.* 50. pp. 707-710, Sept. 1, 1938.—The author's previous measurements of the principal magnetic susceptibilities of $K_3Fe(CN)_6$ have been repeated and extended to a temperature of 14.2° K. Two of the principal susceptibilities are approximately equal throughout the whole temperature range from 290 to 14° K., but that along the third principal axis is considerably smaller. The anisotropy is almost 400% at 14° K. and is still increasing as the temperature falls. A brief comparison with Howard's theory of the magnetic properties of $K_3Fe(CN)_6$ is made. AUTHOR.

3858. Further Measurements of the Magnetostriction of Liquid Oxygen. M. Wolfke. *Acta Physica Polonica*, 7. 1. pp. 81-85, 1938. *In German.*—The magnetostriction of liquid oxygen at its normal boiling point is measured with an improved apparatus. The increase of specific volume produced by a field of H Gauss is found to be $2.0 \times 10^{-14} H^2$.

R. P.

3859. Effect of Temperature on Elastic Modulus of Ferromagnetic Substances. W. Döring. *Ann. d. Physik*, 32. 5. pp. 465-470, July, 1938.—The variation with temperature of the elastic modulus of a Ni-Fe alloy containing 42% Ni, magnetised to different degrees, is described. A value of 1.62×10^{12} dynes/cm². (E_H) is obtained by O. Engler for this alloy at room-temperature and magnetised to saturation whilst by extrapolation from above the Curie Point a value of 1.80×10^{12} dynes/cm². (E_M) is obtained at room-temperature for constant magnetisation; the relative difference $E_M - E_H / E_M$ is thus about 10%. In other alloys and in pure metals the difference is much smaller. The large value of the difference in this particular alloy seems to be due to its large volume magnetostriction effect in comparison with that in other alloys where the differences are too small to be measured experimentally.

H. J. H. S.

3860. Gyromagnetic Effect in Supraconductors. I. K. Kikoin and S. V. Goobar. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 4. pp. 249-251, 1938. *In English.*—A brief description is given of measurements of the gyromagnetic effect on supraconductors, using the resonance method proposed by Einstein. A ball of Pb is used and the current is alternated by means of a special thyatron relay; in this way the secondary effects are practically eliminated. The Einstein-de Haas effect occurs in Pb at the boiling point of liquid He in fields below the critical one and the sign is negative (as would be expected for electrons). The existence of a gyromagnetic effect is thus not due to the influence of

electron inertia in eddy currents (Tolman effect) for these cannot arise in the specimens used. The results will be described in detail later.

H. J. H. S.

See also Abstract 3796 and

2614B. Rheographic and Rheometric Analogies. J. Pérès and L. Malavard.

2617B. Law of Reaction in Electrodynamics. M. Wolfke.

2659B. Permanent Magnets. G. Venco.

MEDICAL RADIOLOGY AND ELECTROLOGY.

3861. Electric Conduction of Self-Polarising Bodies. N. N. Malov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 8. pp. 569-573, 1938. In German.—The phenomena observed on passing current through living tissues (in particular, the frequency relations of the exciting wave and the impedance) show that, at the boundaries of the tissue, a strong polarisation occurs. A theory is developed to account for the complicated frequency relations which occur in animal and human tissues, and graphs are given in illustration. The impedance has 2 components, one "active" and the other "capacitative", each of which is affected by frequency in a different manner. H. J. H. S.

***3862. Radiographic Models.** W. E. Boyd. *Brit. J. of Radiology*, 11. pp. 444-451, July, 1938.—These are models to illustrate the effect of a divergent beam on the projection of shadows from opaque bodies situated at various depths and positions: this effect is, in brief, that the apparent sizes and positions are not identical representations of the actual sizes and positions of the objects. One model is a sheet of wood with opaque drawing pins at various positions in its surface and can be used to show the effect of increasing distance between the pins and the focal spot, on passing out towards the edges of the surface. The other model is a wooden block with pins fixed in its front and back surfaces: this model can be used to illustrate the effect of having the opaque bodies at different depths from the focal spot. G. G.

3863. Physical Measurements in H.V. X-Ray Therapy. R. Phillips and G. S. Innes. *Brit. J. of Radiology*, 11. pp. 498-503, July, 1938.—The paper reports physical measurements of intensity, absorption, quality, scatter and percentage depth dose, made at 700 kV on the h.v. X-ray therapy apparatus at St. Bartholomew's Hospital. Transmission curves and half-value layers have been obtained in Cu, Sn, Pb and H₂O. For preliminary clinical work the filter chosen is 3.2 mm. Fe, 1.5 mm. Al, 2.0 mm. Pb, 2.4 mm. Sn, 0.5 mm. Cu and 1.0 mm. Al, giving an effective wave-length of 0.033 Å. Measurements of back scatter from a wax phantom show a constantly decreasing value with kilovoltage, down to about 10% at 700 kV. The isodose curves show the higher intensity in the half of the beam on the anode side of the vertical axis, as predicted by Corrigan. The variations of depth dose with voltage, filtration, field area, and focus skin distance have been investigated and curves are given; it is shown that filtrations beyond 2.0 mm. Pb give only negligible increases in percentage depth dose. The fact that the maximum percentage depth dose at any depth is a function of the quality of the radiation is illustrated by the curves given. J. E. R.

3864. Geometrical Factors in Measurement of Radiation in Röntgens. C. C. Lauritsen. *Brit. J. of Radiology*, 11. pp. 471-478, July, 1938.—A theoretical discussion of two ambiguities in the definition of the röntgen. (1) It is not stated whether scattered radiation shall be

included or not in the measurement but usage has established that it shall not be included. (2) The definition is based on the ionisation produced per cm^3 in air. It is customary and convenient to measure instead the ionisation produced in an unknown volume by the electrons originating per cm^3 of air at a certain point and this is usually a very different thing. Difficulties arise in the measurements, if the radiation is of short wavelength and the medium is air, then the electrons may have a range of several metres. In the case of γ -rays from a point source, three cases are considered, *i.e.*, measurements in a sphere of air equivalent material of which the radius is 1 cm., 10 cm., and finally the whole range of the electrons, several metres. It is concluded that a suitable thick-walled thimble chamber can be expected to give readings which are independent of distance, in which the compensation is 100%.

T. A. C.

3865. γ -Ray Measurement in Radiology. G. C. Laurence. *Am. J. of Roentgenology and Radium Therapy*, 40. pp. 92-103, July, 1938. —The calibration of thimble chambers for the measurement of γ -rays in roentgens is discussed. The correction that should be applied because the materials used in the walls of these chambers are not generally "air equivalent" is described and data are given for evaluating it under various conditions. When thus corrected the recently published measurements of the intensity of γ -rays filtered through 0.5 mm. of Pt from 1 mg. of Ra in equilibrium with its products at 1 cm. distance agree with a mean deviation of 2% from the value 8.4 roentgens per hour. The design of thimble chambers and phantoms for γ -ray measurement is discussed. Present uncertainties about the meaning of the roentgen under practical conditions have hindered the use of these units in γ -ray therapy. Certain conventions are proposed to remove these uncertainties. The density of ionisation per roentgen in any material varies considerably with the nature of adjacent materials and is probably an important factor in determining the biological effects of γ -ray exposure of the skin. The approximate measurement of the variation in the density of ionisation per roentgen in a solid material is described.

AUTHOR.

3866. Measurements of Radiation Energy and True Tissue Dosage (Energy Absorption) in H.V. Therapy. L. Rovner. *Am. J. of Roentgenology and Radium Therapy*, 40. pp. 104-107, July, 1938. —The increasing agreement found among recent independent evaluations of the air ionisation constant for Ra γ -rays emphasises the present opportunity of next converting this and other ionisation measurements into true dosage values. As demonstrated by Lauritsen only the evaluation of the true energy absorption serves as a proper means for comparing clinical dosages or for investigating biological effects of different radiations. The recent work of Gray has shown that these energy measurements may become established upon a sound theoretical and experimental basis. Since the formation of ions of the liberation of high speed ionising particles in an irradiated medium is always the result of true energy absorption of the radiation in the medium, it is suggested that this absorbed energy quantity, itself, be used to express dosage. In this case the dosage may be stated in ergs or in microcalories of radiation energy absorbed per cm^3 of tissue.

AUTHOR.

3867. Estimation of Dosage from Flat Radium Applicators. M. C. Reinhard and H. L. Goltz. *Radiology*, 31. pp. 151-154, Aug., 1938. —Tables and charts are presented showing the relationship between radiating area and intensity expressed in r./mg.-hr. These were primarily

developed for use in connection with intra-oral applicators of radium, but may be used for any surface applicator at any distance from 0.5 to 5 cm. for areas up to 40 cm².

AUTHORS.

3868. Quantum Processes in Radiobiology. K. Sommermeyer. *Zeits. f. Physik*, 109. 5-6. pp. 332-340, 1938.—It is suggested that neither the passage of a fast electron nor the formation of an ion in a sensitive region of a biological object irradiated by X-rays or γ -rays can be regarded as a hit. A more general definition of an effective hit is put forward. On this basis it is to be expected that for short wave-lengths the half-value dose, and the number of hits required to produce any biological effect, will be independent of the wave-length; for longer wave-lengths variations will occur in accordance with Glocker's theory. J. E. R.

3869. Action of Radiations on Biological Materials Capable of Recovery. Part I. D. E. Lea. *Brit. J. of Radiology*, 11. pp. 489-497, July, 1938.—One cause of the intensity-dependence of the effect produced by a given dose of radiation is the existence of recovery in the biological material irradiated. In cases where a single unit action (ionisation, etc.) only is required to produce the effect, recovery is of no significance and dose is independent of intensity. Theoretical dose-intensity curves are produced for the cases of irradiation of recovering biological materials in which n , the number of unit actions required to produce an effect = 2 and for $n = \infty$. It is shown that for these extreme conditions the curves are of practically identical shape. Satisfactory comparison is made between the theoretical curves and published experimental data on *drosophila* eggs and tissue cultures. [See following Abstract.] J. E. R.

3870. Action of Radiations on Biological Materials Capable of Recovery. Part II. D. E. Lea. *Brit. J. of Radiology*, 11. pp. 554-566, Aug., 1938.—A theory is advanced to explain the delay in division which is one of the effects of radiation upon cells. The theory is based upon the concept of the cumulative dose, and supposes that the cumulative dose in a cell decays exponentially after the end of the irradiation. When it falls below a certain threshold, division is no longer inhibited. This recovery process following irradiation is not essentially different from the recovery during irradiation which in Part I [see preceding Abstract] was postulated to explain the dependence of the effect of radiation upon intensity, and this inter-relation of the two phenomena is demonstrated by consideration of published work on *Arbacia* eggs and on tissue cultures. Fair agreement is obtained between the predictions of the theory and the experimental result. In particular it is shown that the variation of the mitotic count in a tissue culture during a period of some hours following irradiation can be predicted using numerical data drawn exclusively from experiments which ended 80 min. after the irradiation. AUTHOR.

See also Abstract 3608.

OSCILLATIONS AND WAVES.

3871. Determination of the Frequency of an Oscillator With a Condenser. H. Mukherjee. *Indian Journ. Phys.* 12. pp. 195-202, May, 1938.—With an a.c. galvanometer of the form of a watt-meter or a dynamometer null point is obtained under two conditions, namely, (1) when the current through either the fixed or the moving coil is zero and
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(2) when the phase difference between the currents in the two systems of coils is 90° . In the method described, advantage is taken of the second condition. The resistances and the condenser are arranged in the arms of a Wheatstone net, the moving coil in one of the diagonal arms and the fixed coils in series with the current source in the other diagonal arm. It is shown that the phase-difference between the currents in the two systems

of coils is 90° when $\frac{1}{C^2 p^2} = \frac{Q}{P} R \left\{ R + \frac{G(P+Q)}{P+Q+G} \right\}$. AUTHOR.

3872. F-Region of the Ionosphere. R. R. Bajpai and B. D. Pant. *Indian Journ. Phys.* 12. pp. 211-222, May, 1938.—The results of ionisation measurements in the F-region during Oct., Nov. and Dec., 1936, are reported. A number of typical curves showing the diurnal variation of electron density are given and their salient features discussed. Separate existence of the F-region has been observed till a few hours after sunset. Evidence is summarised to show that solar theory of upper atmospheric ionisation is inadequate to explain all the observed phenomena. Either the theory should be modified or some other source or mechanism of electron production should be found out. AUTHORS.

3873. Total Reflection of Electromagnetic Waves in the Ionosphere. S. N. Bose. *Indian Journ. Phys.* 12. pp. 121-144, April, 1938.—Beginning with the microscopic equations of Lorentz, a wave disturbance is represented by equating all varying quantities to the sum of a constant and a variable part, thus: $A = A_0 + A_1 e^S$, where S is an unrestricted function, real or complex, of x , y , z , and t . The electromagnetic equations are then developed and discussed in terms of the electric and magnetic vectors E and H , grad S , θ (the amplitude of θe^S , the variable part of the convection current), and θ_0 the amplitude of the variable charge density. The refractive index, defined as $\mu = (\text{grad } S)/(1/c)(dS/dt)$ is next introduced. It is then shown that when $dS/dt + E \cdot \theta/c^2 = 0$, $(H^2/E^2)(dS/dt) = 0$, so that $H = 0$, and the disturbance loses its wave character. At the same time the flow of energy across the wave front vanishes, and the equation is therefore taken as the definition of total reflection. Although when $E \parallel \theta$, the condition is equivalent to the assumption $\mu = \theta$, in the general case the condition is that of vanishing group velocity. These results are now applied to the ionosphere, and equations for critical frequencies are deduced which in simpler cases agree with the usual formulæ if collision frequency is neglected. In the more general case, however, the critical frequency formula turns out to be that first deduced by Bajpai and Mathur [see Abstract 4220 (1937)], on the assumption that the group velocity is zero at total reflection. Finally the propagation of the disturbance is discussed in the most general case and the critical frequency equations of Bajpai and Mathur arrived at by another method. J. P. A.

3874. Reflection in the Ionosphere. I. Mihul and C. Mihul. *Comptes Rendus*, 207. pp. 220-222, July 18, 1938.—The conclusions of Ionescu and Mihul [see Abstract 704 (1935)] as to partial reflections in the ionosphere have been criticised by Best, Farmer and Ratcliffe [see Abstract 375 (1938)]. This criticism was based on the remark that the composition of certain elementary vibrations reflected at successive layers of the ionosphere would lead to an amplitude of negligible magnitude.

It is claimed that the present rigorous calculations show that an amplitude of notable magnitude can be obtained. The difference between the reflection of waves of broadcast wave-lengths and of short waves is mentioned and the considerations applicable to the two cases are discussed.

G. G.

3875. Effect of Longitudinal Magnetic Field on Conductivity and Refractive Index of Ionised Air. B. N. Singh. *Phil. Mag.* 26. pp. 244-252, Aug., 1938.—Conductivity and refractive index of ionised air have been determined in the presence of applied longitudinal magnetic field. The measurements were made with ultra-short waves of frequency 8.1 ± 10^7 cycles per sec. passing through a discharge-tube containing the ionised air. Variations of the above constants were found as the magnetic field was increased. A complete dispersion formula of the ionised gas in the presence of the magnetic field has been employed for the purpose of verifying the experimentally observed values of the above constants. The values of electron density (N) and collisional frequency (ν) were determined by "probe" method of Mott-Smith and Langmuir. It has been found that the values of conductivity and refractive index do not reach infinity at about gyro-frequency of the incident wave when the magnetic field is increased, as is generally expected, from the approximate formulæ obtained by neglecting the collisional frequency. AUTHOR.

See also Abstracts 3561, 3600, 3699 and

2640B. Absorption of H.F. Energy in Geissler Tubes. V. P. Mihu.

2788B. Abnormal Ionisation in the E-Region. J. A. Pierce.

2789B. Radio Transmission Path and Magnetic Storm Effects. G. W. Kenrick, A. M. Braaten and J. General.

2790B. Sudden Ionospheric Disturbances. J. Maire.

2791B. Limit Waves and the Ionosphere. O. Burkard.

2792B. Dispersion of Electromagnetic Waves above the Earth's Surface. J. L. Alpert, V. V. Migulin and P. A. Riasin.

2801B. H.F. Technique. K. Krüger.

PHOTOELECTRICITY.

3876. Effect of H.F. Oscillations on Photoelectric Currents. T. Terada. *Kyoto Coll. Sci., Mem.* 31. pp. 39-46, May, 1938. In English.—The electric current from a photo-cell increases when a very high frequency oscillation of a few volts is superposed upon a continuous voltage. This peculiar effect depends upon the intensity of illumination and the frequency of the oscillatory voltage, but is nearly independent of the temperature. The effect may be explained at least partly by the disturbances of the negative charge accumulated in front of the cathode of the cell. From this point of view, it is suggested that a critical frequency of the electrons in the cell is about 2140 kc./sec. AUTHOR.

3877. Photoelectric Sensitivity of ZnO. E. Hoja. *Zeits. f. phys. Chem.* 40. Abt.B. 4. pp. 263-272, 1938.—From a study of two different samples of ZnO and of the effect of changing the amount of hydrated water it is concluded that the presence of the latter increases the magnitude of the Becquerel effect. If the hydrated oxide plays the part of a cathode depolariser the results may be reconciled with Baur's theory. G. C. E.

***3878. Photoelectric Contact-Making Galvanometer.** W. L. Carson. *Gen. El. Rev.* 41. p. 314, July, 1938.—A brief account of the instrument and its applications is given. The mirror of a galvanometer reflects a light beam upon a scale, where two adjustable photo-cells intercept it for any desired set values indicated by pointers. Each photo-cell

actuates an electronic relay. The principal application of the instrument probably lies in the field of temperature control. L. A. W.

See also Abstract 3807.

PIEZOELECTRICITY.

3879. Velocity of Propagation of Elastic Waves in Piezoelectric Crystals. E. Baumgardt. *Comptes Rendus*, 206. pp. 1887-1890, June 20, 1938.—For plates of piezoelectric crystals of thickness e , calculations based on the values of the elastic constants are found to give values for the product of frequency (f) and thickness which are smaller than the values found experimentally. Thus the value found for quartz is $fe = 283.8$, f being in kc/sec., whereas experimental values range between 285.9 and 287.5, the value generally accepted being 287.0. It is considered that the volume charges created in a vibrating quartz plate by the variation in space of the polarisation vector, tend to increase the value of E^1 (a coefficient similar to Young's modulus) and, in consequence, the value of f . Calculations made on this assumption give for quartz a value for fe of 285.2. It is concluded that the small difference still existing between this and the experimental figure is due to lack of exactness in determining one of the elastic constants, into the calculation of which 6 different coefficients enter. A. W.

THERMIONICS.

3880. Electron-Optical Examination of Electronic and Ionic Emission from Wires. H. Mahl. *Zeits. f. Physik*, 108. 11-12. pp. 771-776, 1938.—A method is described using an auxiliary electrode for converting ionic emission into secondary electron emission so that, if a wire emits both positive and negative particles, each leads to images formed by the same lens on the same screen. The method is illustrated by experiments on an indirectly heated steatite tube. H. J. H. S.

See also Abstracts 3520, 3760.

THERMOELECTRICITY.

3881. Method of Least Squares and Thermoelectric Power of Rhodium. H. T. Wensel and L. B. Tuckerman. *Rev. Sci. Instruments*, 9. pp. 237-241, Aug., 1938.—The paper by Booth and Dixon [see Abstract 5132 (1937)] is critically reviewed. The care necessary in the application of the method of least squares to physical data is discussed with references to articles giving detailed treatments. The method of least squares is then applied to Booth and Dixon's data. It is shown that: (1) The conclusions drawn by Booth and Dixon are invalid because based upon an invalid use of the method of least squares. (2) Their data are inadequate to prove the existence of a discontinuity. (3) No discontinuity of the order of magnitude reported by Booth and Dixon exists in the thermoelectric power of Rh in the neighbourhood of 1100° C. (4) No valid evidence has been adduced for a change in structure of Rh in the neighbourhood of 1100°C. In fact evidence is to the contrary. (5) Other reported "irregularities" of the behaviour of Rh in the neighbourhood of 1100°C can reasonably be ascribed to the formation and decomposition of a surface film of rhodium oxide. Reply by E. T. Booth and E. H. Dixon, *ibid.* pp. 242-243. AUTHORS.

See also Abstract 3814.

A star (*) indicates that the Abstract deals with Apparatus and Instruments.

OCTOBER, 1938.

GENERAL PHYSICS.

ADSORPTION (see Surface Properties).

ATOMIC AND MOLECULAR STRUCTURE.

3882. Probability of Radiative Transitions in Nuclei. B. Pontecorvo. *Comptes Rendus*, 207. pp. 230-232, July 18, 1938.—Arguments are adduced in support of the view that the probability per unit of time of radiative dipole or quadripole transitions is ordinarily of the order of 10^{12} – 10^{13} sec⁻¹. C. A. S.

3883. Deviation of the Nuclei of ${}^4_2\text{He}$ and ${}^{16}_8\text{O}$ from the Hartree Model. B. O. Grönblom. *Zeits. f. Physik*, 110. 1-2. pp. 37-57, 1938.—A method of calculating the second-order perturbation energies of the two light nuclei ${}^4_2\text{He}$ and ${}^{16}_8\text{O}$, taking into account nuclear forces in their relation to nuclear structure, is presented. In the case of ${}^{16}_8\text{O}$ it is shown that the fraction of the mass-defect which is explainable on theoretical lines is thus increased from 26.5% to 51.5%. By an extension of the work of Nakabayasi, and Inglis and his own work, the author is able to express the nuclear energy not only as the first member of a series in the case of heavy nuclei but by means of a closed expression; this enables corrections to be applied to results previously obtained. J. S. G. T.

3884. Separation of Isotopes. F. W. Aston. *Science and Culture*, 4. pp. 22-23, July, 1938.—A brief summary of the chief methods tried in succession for the separation of isotopes from the time of their discovery. N. M. B.

3885. New Method for Separating Isotopes. A. Kastler. *Comptes Rendus*, 207. pp. 146-148, July 11, 1938.—The new method is based on the fact that the metastable atomic levels of the various isotopes of the same element may have very different durations of life. The method has not yet been actually tried, and would involve two successive electronic bombardments of an atomic jet. C. A. S.

3886. Electron Diffraction Examination of Linear High Polymers. K. H. Storks. *Am. Chem. Soc.*, J. 60. pp. 1753-1761, Aug., 1938.—Electron diffraction experiments have been carried out upon very thin films of several synthetic polyesters and natural gutta-percha. Stretched films show diffraction patterns characteristic of sharply oriented crystals. Measurements upon these patterns are in excellent agreement with existing X-ray data upon the same materials. The utility of the electron diffraction method for structural studies of polymerised substances is thus demonstrated. Unstretched films of gutta-percha are found to be composed of relatively large crystallites which are precisely oriented with their fibre axis directions normal to the film surface. It is presumed that the macromolecules are folded back and forth upon themselves in such a way that adjacent sections remain parallel. Unstretched films of polyethylene sebacate consist of relatively small crystals which are believed

to be oriented with their fibre axis directions approximately in the plane of the film, but with limited rotation around the fibre axis directions.

AUTHOR.

3887. Magnetic Properties and Structure of Manganous and Cobaltous Dipyrindine Chlorides. D. P. Mellor and C. D. Coryell. *Am. Chem. Soc., J.* 60. pp. 1786-1787, Aug., 1938.—The magnetic criterion for bond type indicates that Mn and Co atoms in the dipyrindine dichloride compounds form ionic bonds rather than covalent dsp^2 bonds. It is suggested that an octahedral ionic type of structure occurs in the Mn and α -Co compound and a tetrahedral ionic type occurs in the β -Co compound.

AUTHORS.

3888. Molecular Structure of As_4O_6 , P_4O_6 , P_4O_{10} , and $(CH_2)_6N_4$. G. C. Hampson and A. J. Stosick. *Am. Chem. Soc., J.* 60. pp. 1814-1822, Aug., 1938.—Electron diffraction measurements on arsenious oxide, phosphorus trioxide and hexamethylenetetramine show that the molecules consist of four P or N atoms in positions $(\overline{vvv})$ $(\overline{vvv})$ $(\overline{vvv})$ and $(\overline{vvv})$ and six O atoms or methylene groups in the positions $(\pm u00)$ $(0 \pm u0)$ and $(00 \pm u)$. In P_4O_{10} there are four additional O atoms in the positions $(\overline{www})$ $(\overline{www})$ $(\overline{www})$ and $(\overline{www})$. The interatomic distances and angles are: for As_4O_6 , As-O = 1.80 ± 0.02 Å, O-As-O = $100 \pm 1.5^\circ$, As-O-As = $126 \pm 3^\circ$, for P_4O_6 , P-O = 1.65 ± 0.02 Å, O-P-O = $99 \pm 1^\circ$, P-O-P = $127.5 \pm 1^\circ$, for $N_4(CH_2)_6$, C-N = 1.47 ± 0.02 Å, C-N-C = N-C-N = 109.5° , for P_4O_{10} , P-O = 1.62 ± 0.02 Å, P-O' = 1.39 ± 0.02 Å, O-P-O = $101.5 \pm 1^\circ$, P-O-P = $123.5 \pm 1^\circ$ and O-P-O' = $116.5 \pm 1^\circ$. The shortening of the bond distances in As_4O_6 , P_4O_6 and P_4O_{10} below the theoretical single-bond values is attributed to single-bond double-bond resonance. It is concluded that the abnormally low value of 1.39 Å for the P-O' bond in P_4O_{10} is due to the polar character of the bond.

AUTHORS.

3889. Structures of P and Si Compounds. L. O. Brockway and J. Y. Beach. *Am. Chem. Soc., J.* 60. pp. 1836-1846, Aug., 1938.—The molecular structures of seven P compounds have been investigated. The P-F bond distances in the PX_3 and POX_3 (X = halogen) molecules are all close to 1.52 Å, and in PF_5 and PF_3Cl_2 are 1.57 and 1.59 Å. An increase in bond length with coordination number occurs at coordination number five but not four. The observed lengths are all smaller than the covalent radius sum, 1.74 Å. The P-Cl bond lengths show similar variations but the decreases below the radius sum, 2.09 Å, are only from 0.04 to 0.08 Å. The XPX bond angles increase by 4° in going from PX_3 (102°) to POX_3 (106°). The P-O bond, 1.56 Å in length, is a double bond and stands at angles of 112° to the three P-X bonds. In Si_2H_6 the Si-Si bond length is 2.32 ± 0.03 Å, within 0.02 Å of the length in elementary silicon. In $SiHCl_3$ and Si_2Cl_6 the Si-Cl bonds are 2.01 ± 0.03 Å, and 2.00 ± 0.05 Å; the same value has been observed in $SiCl_4$. This value is 0.15 Å below the Si-Cl radius sum. The ClSiCl angle in $SiHCl_3$ is distorted from the tetrahedral value by less than 1° .

AUTHORS.

3890. Structure of $AlCl_3$, $AlBr_3$ and AlI_3 . K. J. Palmer and N. Elliott. *Am. Chem. Soc., J.* 60. pp. 1852-1857, Aug., 1938.—It is shown that in the gaseous state the dimeric molecules of aluminium chloride, bromide, and iodide consist of two tetrahedra sharing an edge with six halogen atoms at the corners, each tetrahedron containing one Al atom. The final values of the interatomic distances are given.

AUTHORS.

3891. Molecular Structures of CF_4 and SiF_4 . C. R. Bailey, J. B. Hale and J. W. Thompson. *Roy. Soc., Proc.* 167A. pp. 555-566, Sept. 23, 1938.—The infra-red absorption spectra of gaseous CF_4 and SiF_4 have been examined between 1 and $18\ \mu$ with a prism spectrometer. Data obtained for the Raman spectra by other workers have helped in the assignment of fundamental modes and combination tones. The Urey and Bradley force system provides a satisfactory picture of the two molecules, and the force constants for this and other systems have been calculated. The molecular structures are discussed with particular reference to the interatomic distances and extent of electron pair bond formation.

AUTHORS.

3892. Structure of Dihalogen Derivatives of Cyclohexane. J. G. Gudmundsen and O. Hassel. *Zeits. f. phys. Chem.* 40. Abt. B. 5. pp. 326-332, 1938.—The results of electron diffraction experiments with the vapours of dichloro-, dibromo-, and diiodo-cyclohexane are given.

A. J. M.

3893. Allotropes of S. S. R. Das. *Indian Journ. Phys.* 12. pp. 163-181, May, 1938.—The modifications of S existing between -183°C . and 130°C . have been investigated by the X-ray powder photograph method with the following results:—Roll S and "flowers of sulphur" are the same as the orthorhombic form S_α . Milk of sulphur and the so-called amorphous forms are really S_α , but plastic S is really amorphous, though it rapidly changes into S_α . White S obtained by the hydrolysis of S_2Cl_2 is crystalline but different from S_α into which it is transformed if it is heated to 88°C . Using specimens of S_α at temperatures between 80°C . and 110°C . there are obtained discontinuity of rings, asterism and the appearance of sharp spots; these effects are due to the change from S_α to S_β . No satisfactory results were obtained from S_β itself. The author suggests that the insolubility of various forms of S is due to a layer of oxide on the surface of the crystallites. Liquid S was also investigated.

G. G.

3894. Molecular Association of Acetic Acid. P. Koteswaram. *Zeits. f. Physik*, 110. 1-2. pp. 118-133, 1938.—The Raman spectrum of acetic acid has been examined in solutions of H_2O , C_6H_6 , and CCl_4 . In aqueous solution a variation in the Raman frequencies is observed, which is not exhibited in the non-polar solvents. Increase in temperature, however, produces a similar variation. The variation is attributed to the decomposition of the highly polymerised acid into lower polymers which can be produced either by solution in a polar solvent or by heating. The structure of the hydrates of acetic acid is discussed.

W. R. A.

3895. Molecular Weights of Globular Proteins. D. M. Wrinch. *Phil. Mag.* 26. pp. 313-332, Sept., 1938.—The further consideration of the cyclol theory shows that its predictions and general point of view are in good accord with the findings of Svedberg. The shape of the C_n cyclols and the nature of the cyclol network suggest that compound cyclols may exist, and it is found that the actual numbers given by Svedberg for fourteen different molecular weight classes may all be represented by simple or compound cyclols on the assumption that the corresponding apparent residue weights lie between 121 and 128. The consideration of compound cyclols suggests a simple interpretation of the reversible dissociation characteristic of many proteins, and explains in particular the effect of dilution and changes in pH on the molecular weights of such

proteins. A cage-colony structure is proposed for the virus proteins and other heavy proteins. AUTHOR.

See also Abstracts 3981, 3999, 4098, 4148, 4159, 4209, 4213.

COLLOIDS.

3896. Optical Properties of Cellulose Dispersed in Cuprammonium Hydroxide. J. Compton. *Am. Chem. Soc., J.* 60. *pp.* 1807-1812, *Aug.*, 1938.—The successive lowering of the cuprammonium viscosity of native cotton fibres by the action of dilute acids or mild oxidising agents is not accompanied by a change in the optical activity of the resulting dispersions, a conclusion in agreement with the work of Hess on celluloses of low viscosity. It follows that the optical activity of cellulose dispersions in cuprammonium solutions is dependent upon the formation of a cellulose particle-copper complex. Quantitative examination of various celluloses dispersed in cuprammonium solutions, using the slit ultramicroscope, reveals the presence of approximately the theoretical number of cellulose particles ($1.1 \times 1.5 \mu$). Further evidence that cellulose-copper compound formation precedes dispersion of cellulose in cuprammonium solution is presented. Visible cellulose particles ($1.1 \times 1.5 \mu$) observed in the living cytoplasm, cellulose fibres and dispersions of cellulose in cuprammonium solution possess the essential features, with the exception of size and shape, of the hypothetical micelles. AUTHOR.

3897. Viscosity Function of Disperse Systems. F. Frimberger and J. Rehme. *Kolloid Zeits.* 84. *pp.* 196-199, *Aug.*, 1938.—The representations in a plane diagram of the three variables essential to the discussion of the viscosity of disperse systems, *viz.*, (1) the total viscosity of the disperse system as a whole, (2) the viscosity of the fluid in which the dispersion is produced, and (3) the total volume of the disperse phase, is discussed. The method is illustrated by the plotting of results relating to the viscosities of suspensions of red blood corpuscles in 3.8% citrate solution containing various proportions of gum arabic. J. S. G. T.

3898. Source of Error in Micro-Kataphoretic Measurements with a Cell of Cylindrical Bore. D. C. Henry. *Chem. Soc., J.* *pp.* 997-999, *July*, 1938.—Difficulties in locating the level of observation in a cylindrical-bore micro-kataphoretic cell of the Matson type are considered, especially in the case when the fine focusing adjustment of the microscope is used. A. J. M.

3899. Electrochemistry of Congo-Dye Sols. W. Pauli and P. Szarvas. *Kolloid Zeits.* 84. *pp.* 179-186, *Aug.*, 1938.—This paper records the potentiometric determination of the H-ion activities (glass electrode) and the derivation of the activity and conductivity coefficients of the related ions of a highly purified negative hydrophobic sol, such as Congo Blue, at various dilutions. Various characteristics are described for polyvalent colloidal electrolytes (hydrophilic and hydrophobic). The neutralisation relationships for Congo-dye sols with caustic alkalies are tested also by means of potentiometric measurements in the alkaline domain. Thereby it is shown that near the neutral point every millimol of dye consumes 2 millimols of caustic alkali, and that within pH 8 to 12, a still further union of alkali takes place up to a limiting value of 4 millimols per millimol of dye, *i.e.*, the formation of a hitherto unknown tetravalent colour anion is established. The constitutional problems involved in this proton release of the colour molecule are discussed and the possible application explored. H. H. Ho.

***3900. Electrodialysis.** H. de Bruyn and S. A. Troelstra. *Kolloid Zeits.* 84. pp. 192–196, Aug., 1938.—The theory of electrodialysis is briefly explained, and apparatus, based upon the method due to Pauli, for the electrodialytic purification and concentration of hydrophobic sols, employing a much reduced quantity of wash-water is described and illustrated. J. S. G. T.

3901. Silver Chromate Banding in Silicic Acid Gel. T. Isemura. *Chem. Soc. Japan, Bull.* 13. pp. 484–493, July, 1938.—The formation of silver chromate bands in silicic acid gel, which was made by a usual method, is described. By this procedure, the concentration of chromate is regulated at will, and distinct banding is formed. The H ion concentration of the gel has a profound influence on the formation of rhythmic band of silver chromate. Dhar and Chatterji's theory and the membrane theory are not applicable. AUTHOR.

3902. Calcium Phosphate Banding in Silicic Acid Gel. T. Isemura. *Chem. Soc. Japan, Bull.* 13. pp. 493–504, July, 1938.—The formation of rhythmic precipitate of calcium phosphate in a silicic acid gel is described. It is strongly affected by the H-ion concentration of the gel. The effects of the concentrations of inner and outer electrolytes, and gel were also studied. When the concentration of the inner electrolyte (CaCl_2), is sufficiently great, no diffusion of the outer electrolyte into the gel takes place but reversely Ca salt diffused into the outer electrolyte solution and dendrities were formed in the outer solution. The effect of the existence of a third substance in the gel and in the diffusing electrolyte, was also investigated. The existence of it in a diffusing electrolyte had almost no influence but the existence in a gel had some effects, especially in the case where bromide and iodide of potassium were used as the third substance. AUTHOR.

3903. Quantitative Investigations on Rhythmic Precipitation. K. Neumann and V. Costeanu. *Kolloid Zeits.* 84. pp. 130–138, Aug., 1938.—The dependence of the rhythmic precipitation of Ag_2CrO_4 in gelatin on the initial concentrations of the reagents, the acidity of the gelatin, and temperature has been investigated. The results agree with the supersaturation theory. A. J. M.

See also Abstracts 3895, 3919, 3942, 3968, 4181.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

3904. Energy Levels in Real and Ideal Crystals. N. F. Mott. *Faraday Soc., Trans.* 34. pp. 822–827; *Disc.*, 832–834, Aug., 1938.—An ionic crystal such as rock-salt does not show metallic conduction and may therefore be said to contain no "free" electrons. This does not mean that the electrons in the negative ions are prevented by a potential barrier from moving into an adjacent negative ion; owing to the quantum mechanical "tunnel effect" an electron can pass freely through the potential barrier separating the ions. The absence of current is due rather to the Pauli exclusion-principle; the crystal is built up of ions having the electronic configuration of a closed shell. An electron cannot pass from one ion to its neighbour because all the energy states of the latter are occupied. The conditions under which a current can exist in a polar crystal are considered. Electronic energy levels at singular points in the lattice are discussed in the light of the theories of Jost, Schottky and Wagner, according to which there exist a number of lattice points

in a polar crystal from which the ions are missing. At high temperatures these vacant points are mobile, and are responsible for the electrolytic conduction of the salts. At lower temperatures they become immobile; the number depends on the past history of the crystal. The problem of the energy levels at the surface and at cracks, and due to colloidal metal particles are outlined.

C. J. B. C.

3905. Excited Energy Levels of Insulating Crystals. J. C. Slater. *Faraday Soc., Trans.* 34. pp. 828-832; *Disc.*, 832-834, Aug., 1938.—The wave functions for normal states of insulating crystals are well understood, but three principal theories have been put forward to explain the excited states. Electronic excitation may be caused in various ways, but only optical excitation is considered here. The first theory considers the atoms or ions in the crystal as if they were in empty space. Light can be absorbed by one of the ions or atoms of the crystal either by raising it to an excited level or ionising it. The processes by which it can return to the normal state are enumerated, and a simple theory for simple alkali halide crystals is outlined. Its shortcomings are evident when it is compared with the methods used to describe the normal states. The next stage in the development is to suppose that the process of excitation consists in the removal of an electron from one of the levels of a filled band into an unfilled level. Only finite excitation is necessary to produce conductivity in such a crystal. The normal state consisting of filled bands causes no current, but in the excited state the electron travels through the crystal and a current is possible. The more simple theory seems nearer the truth than the quantum theory based on energy bands. The refinements of the theory by the application of perturbations to the wave theory, leads to a theory of excited states similar to the simple theory and promises to give more accurate results.

C. J. B. C.

3906. Electronic Structure of Metals. J. Farineau. *Ann. de Physique*, 10. pp. 20-102, July-Aug., 1938.—Essential points of the electronic theory of metals are emphasised and the theories put forward to explain the wide bands emitted by metals in the X-ray region are reviewed critically. A theory is proposed which predicts certain particulars in the distribution of the intensity of these bands. The apparatus for the investigation of Mg, Al, and Si between 5 and 16 Å is described. The experimental data yield information on the distribution of the electrons in these metals in the crystalline state. Comparison of the results obtained using Al in the solid and liquid states reveals that the electronic structure in both states is very similar. Study of Al-Mg alloys shows that the valence electrons of the two metals are shared. The *L* bands of Co, Ni, Cu, and Zn have been studied and information on the structure of the 3*d* and 4*s* levels is obtained.

W. R. A.

3907. Atomic Vibrations in Mg. G. W. Brindley and P. Ridley. *Phys. Soc., Proc.* 50. pp. 757-766, Sept. 1, 1938.—Measurements are made of the intensities of X-ray reflections from Mg powder at 86° and 293° K. Absolute values of the ratio I_{86}/I_{293} are obtained by making comparative measurements on a composite specimen of Mg and Al powders. The results are discussed in relation to theoretical work by Zener and others on the effect of lattice vibrations in hexagonal metals on the intensities of X-ray reflections. It is shown that in Mg the lattice vibrations are almost isotropic but that the mean atomic displacements in the basal plane are about 3% greater than those parallel to the *c* axis. Values are calculated for the mean atomic displacements in these directions at 86°

and 293° K, and the results are also expressed in terms of characteristic temperatures Θ_0 (parallel to the c axis), equal to 339°, and Θ_{90} , equal to 327°. A consideration of these results, in conjunction with similar results for other hexagonal metals, points to a correlation between the departure of the axial ratio from the ideal value 1.633 and the asymmetry of the lattice vibrations.

AUTHORS.

3908. Interaction of Atoms in Alloys. W. Shockley. *J. Chem. Phys.* 6. pp. 523–525, Sept., 1938.—A generalisation of Bethe's theory of superlattices so as to take into account the interactions between atoms which are not nearest neighbours in the lattice is considered. This process will not furnish any great improvement in agreement between theory and experiment because it predicts, in disagreement with experiment, that many properties of binary alloys are symmetrical between the two constituents. It is further shown to be in disagreement with certain fundamental features of the interactions of atoms in alloys.

AUTHOR.

3909. Al-Mg System. F. Laves and K. Moeller. *Zeits. f. Metallkunde*, 30. pp. 232–235, July, 1938.—An X-ray examination of the Al-Mg system using Cu K_α radiation shows that four intermediate phases exist (δ , δ^1 , γ , β). Hitherto only three phases have been recognised. The δ -phase has an α -Mn structure whilst the δ^1 has a similar but distorted structure. The γ - and β -phases give different X-ray patterns, each containing many lines; the β -phase pattern is very similar to that of the compound Cu_4Cd_3 . The existing phase diagram of the system is modified to take into account the four phases.

H. J. H. S.

3910. X-Ray Investigation of Slowly Cooled Cu-Ni-Al Alloys. A. J. Bradley and H. Lipson. *Roy. Soc., Proc.* 167A. pp. 421–438, Sept. 6, 1938.—From an X-ray examination of slowly cooled Cu-Ni-Al alloys, a phase diagram has been constructed. The boundaries of the single-phase, two-phase and three-phase fields have been fixed from powder photographs. A novel feature of the work is the use made of the relative intensities of the X-ray reflections to estimate the proportions of the constituents in two- and three-phase alloys. The single-phase fields are derived from the Cu-Al and Ni-Al systems, with the exception of τ (Cu_3NiAl_6), which has a new type of structure, derived from a deformed body-centred cube.

AUTHORS.

3911. Lattice Constants of Non-Cubic Substances (Bi, Mg, Sn) by the Asymmetric Method. A. Ieviņš, M. Straumanis and K. Karlsons. *Zeits. f. phys. Chem.* 40. Abt.B. 5. pp. 347–356, 1938.—In order to test the applicability of the asymmetric method of taking Debye-Scherrer X-ray photographs the lattice parameters of Bi, Mg, and Sn are measured. The following values are obtained:—

Bi— $a=4.53674 \pm 0.00004$, $c=11.83834 \pm 0.00004$, $c/a=2.60944$;

Mg— $a=3.20280 \pm 0.00003$, $c=5.19983 \pm 0.00005$, $c/a=1.62353$;

Sn— $a=5.81970 \pm 0.00002$, $c=3.17488 \pm 0.00005$, $c/a=0.54554$.

These results are in good agreement with those of other authors, but it is claimed that they have a higher precision, viz., 0.001%.

J. I.

3912. Structure of Co_2Al_5 . A. J. Bradley and C. S. Cheng. *Zeits. f. Krist.* 99. 6. pp. 480–487, 1938. *In English*.— Co_2Al_5 is hexagonal with $a=7.656$, $c=7.593$ Å and $4\text{Co}_2\text{Al}_5$ in the unit cell, space group D_{6h}^{4-} -C6/mmc. The 28 atoms are arranged in or near four equidistant planes, 7 in each, perpendicular to the hexagonal axis. Atomic distances and diagrams showing relative positions are given.

C. A. S.

3913. Structure of KHF_2 . V. Caglioti and G. Giacomello. *Ricerca Scientifica*, 9. pp. 545-549, June, 1938.—The unit cell of KHF_2 is tetragonal, $a = b = 7.98$, $c = 6.74 \text{ \AA}$, and contains 8 molecules. The most probable space group is D_4 . From intensity measurements a Patterson analysis is made, and diagrams are given to show the positions of the atoms in the cell. The distance K-F is found to be $2.65 \text{ \AA}$.

C. J. B. C.

3914. Structure of $\text{Cs}_2\text{AuAuCl}_6$, and $\text{Cs}_2\text{AgAuCl}_6$. N. Elliott and L. Pauling. *Am. Chem. Soc.*, J. 60. pp. 1846-1851, Aug., 1938.

3915. Ice. W. H. Bragg. *Roy. Inst., Proc.* 30. 2. pp. 283-301, 1938.—The structure of ice as determined by X-rays is described and connected with its plastic and elastic behaviour, and shown (with its peculiar maximum density law) to account for the motion of glaciers. Formation of slip planes is explained; and absence of cold-working effect in ice attributed to non-formation of small crystals on such working. The behaviour of single crystals of Cu is contrasted. Sublimation and condensation and formation of snow flakes is described, and lastly the differences between the structures of Ices I, II and III are explained.

C. A. S.

3916. Comparison of Rotated-Crystal and Powder Methods. M. Straumanis and A. Ievinš. *Zeits. f. Physik*, 109. 11-12. pp. 728-743, 1938.—The authors have applied their method for the accurate determination of lattice constants to the method of rotated single crystals. A comparison of the results of both methods for rock-salt shows that both methods are equally applicable. The data are for rock-salt: lattice constant of powdered rock-salt $5.62747 \pm 0.0003 \text{ \AA}$ and of single crystals $5.62735 \pm 0.00002 \text{ \AA}$ at 18°C . The difference in the two values can be explained by absorption in the single crystals and by the heating of the powder. Experiments with $\text{Co}[\text{Hg}(\text{CNS})_4]$ showed that the lattice constants of different crystals differed from each other by $0.008 \text{ \AA}$. In this case the two methods furnish the same results only if the powder and the crystals have exactly the same chemical composition. The lattice constants of $\text{Co}[\text{Hg}(\text{CNS})_4]$ are: $a_{25} = 11.08944 - 11.09756 \text{ \AA}$, $c_{25} = 4.36465 - 4.36524 \text{ \AA}$, $\alpha_1 = -10.85 \times 10^{-6}$, $\alpha_{11} = +149.3 \times 10^{-6}$.

L. K.

3917. Infra-Red Study of Liquid Crystals. R. Taschek and D. Williams. *J. Chem. Phys.* 6. pp. 546-552, Sept., 1938.—The near infra-red spectra of three liquid crystals have been studied in the isotropic and anisotropic phases, and several band shifts have been observed. A detailed study of the transmission as a function of temperature was made at various wave-lengths. Pronounced changes in transmission were observed at melting and clearing points, the magnitude of the changes being greater at short wave-lengths. Rapid variations in transmission occurred in the mesophase. A qualitative explanation of the observed changes is given in terms of Ornstein's theory of scattering. The application of infra-red methods to the study of changes of state is discussed.

AUTHORS.

3918. Etch Figures of Quartz. W. L. Bond. *Zeits. f. Krist.* 99. 6. pp. 488-498, 1938. *In English*.—A hollow section of right-handed quartz, slightly less than a hemisphere, was polished inside, and ground smooth and spherical outside. The spherical surface was etched for 1 hr. with aqueous HF (the interior being protected with paraffin). Microphotographs ($\times 70$) of all the 36 varieties of etch figure were taken

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and are reproduced. The orientation of the area over which each extends is noted on a stereographic projection. C. A. S.

See also Abstracts 4064, 4113, 4155, 4156, 4239, 4243, 4245.

DENSITY.

See Abstracts 3981, 3983.

DIFFUSION AND OSMOSIS

3919. Process of Diffusion in a Centrifugal Field of Force. Part II. W. J. Archibald. *Phys. Rev.* 54. pp. 371-374, Sept. 1, 1938.—The general equation for the settling of particles and molecules in a liquid suspension or ideal solution has been solved for the case of a cell with radial sides and two bounding cylindrical ends. A set of curves is given which shows the concentration at all points in the cell for different values of the time. [For Part I see Abstract 2254 (1938).] AUTHOR.

3920. Diffusion of Electrolytes in Solution. K. Sitte and V. Daniel. *Zeits. f. phys. Chem.* 182. Abt.A. 4. pp. 295-318, 1938.—Diffusion processes in solutions of electrolytes (LiCl, LiBr, NaCl, NaBr, NaI, KCl, KBr, KI) in H_2O have been studied. The diffusion of these electrolytes can be represented by a differential equation of the Boltzmann type. Two methods of calculating the diffusion coefficient are given. For very small concentrations the coefficient decreases with concentration according to a square root law as required by the Debye-Hückel theory, but even at concentrations of about 0.05 *M* the value was considerably greater than the theoretical for all the substances investigated, and increases further with increasing concentration. This may be explained as due to ionic association of the type assumed by Bjerrum, and the interaction of ions with the H_2O dipoles according to Born's theory. Investigations with solutions of LiCl in CH_3OH and C_2H_5OH and of NaI in C_2H_5OH gave higher values for the diffusion coefficient than the theoretical. These deviations may be explained in the same way as for aqueous solutions. The migration of ions of strong electrolytes in H_2O , CH_3OH , and C_2H_5OH can be completely explained by the interionic forces and the interaction between the charged ions and the dipoles of the solvent. It is unnecessary to assume any special forces for aqueous or alcoholic solutions. A. J. M.

3921. Variation of Osmotic Pressure, Heat of Dilution and Dilution Entropy of High-Molecular Solutions with Temperature. G. V. Schulz. *Zeits. f. phys. Chem.* 40. Abt.B. 5. pp. 319-325, 1938.—Two equations are available for the calculation of heat of dilution from the variation of osmotic pressure with temperature according as whether the composition of the solution or its volume remains constant. An exact relationship is derived for the second case. The heat of dilution previously calculated from the variation of osmotic pressure of solutions of nitrocellulose in acetone and polystyrene in toluene with the aid of the Helmholtz equation are about 30% too low. The dilution entropy is found to be identical in value with the mixing entropy. Hence deviations of the osmotic pressure from the values given by the van't Hoff equation are due only to forces between the molecules of the solute and the solvent. A. J. M.

See also Abstract 3969.

ELASTICITY AND PLASTICITY.

3922. Elastic Constants of Transparent Isotropic Solids. K. H. Hoesch. *Zeits. f. Physik*, 109. 9-10. pp. 606-624, 1938.—Supersonic vibrations, both longitudinal and transversal, are produced by an oscillating quartz crystal in the solid (usually glass) and are made visible by the refraction and polarisation which they produce. Their wave-length can be measured under the microscope and in this way the elastic constants can be determined within about 1% error. R. P.

3923. Temperature Dependence of Tension in Rubber. V. Hauk and W. Neumann. *Zeits. f. phys. Chem.* 182. *Abt. A.* 4. pp. 285-294, 1938.—Apparatus is described for determining the variation of the tension in rubber with temperature, the extension remaining constant. Three types of vulcanised rubber were used, and for all three the decrease of tension was proportional to the absolute temperature. The tension coefficient for the greater extensions is dependent on the extent of vulcanisation, increasing with the S content of the rubber. The results are discussed and an explanation is offered. A. J. M.

3924. Subpermanent Deformations. J. Galibourg and P. Laurent. *Comptes Rendus*, 207. pp. 34-35, July 4, 1938.—A number of further results upon the subpermanent deformation of plexigum are given. W. G. B.

3925. Vibration of a Bar Bent along a Circular Arc. T. Ikebe. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers*, No. 796. pp. 680-712, July, 1938. *In English.*—The frequency of the fundamental mode of a circular ring with a small gap vibrating in its plane is calculated by the Rayleigh-Ritz method. Experimental results differed from the calculated one by about 1%, so the value was redetermined from the differential equations, which showed the original theoretical result to be accurate to four figures, and this is confirmed by applying the Rayleigh-Ritz method to an almost straight bar. The rotational energy is too small to explain the discrepancy, which is finally attributed to the difference between dynamical and statical values of Young's modulus. W. G. B.

3926. Rupture. P. W. Bridgman. *J. of Applied Physics*, 9. pp. 517-528, Aug., 1938.—Rupture must be considered as essentially a problem in stability, and one would not expect any general criterion of rupture in terms of ordinary large-scale stress and strain. Changes in atomic positions leading to instability may be of various types, but the discussion is mainly confined to cases in which unusually large extensions in particular directions occur. In this way rupture which occurs on the release of pressure or against the stress, such as in the case of a glass rod subjected over a portion of its length to high pressure over its curved surface, and which shows a characteristic "tensile" rupture, and others, are explicable. W. G. B.

See also Abstracts 3948, 4180, 4184.

GRAVITATION.

3927. Rapid Measurement of Relative Value of g . G. Bertrand. *Comptes Rendus*, 207. pp. 356-357, Aug. 8, 1938.—A weight Mg is supported by a vertical wire of ferromagnetic material, e.g., invar, which vibrates with fundamental frequency, F , between the poles of a horseshoe magnet, around which a bobbin is wound; F is deduced from the frequency of the current therein induced with an accuracy of $1/10^6$. Variations in g

are deduced from the equation $2 F = L\sqrt{Mg/\mu}$. The arrangement is standardised by varying M . Necessary precautions and corrections are described.

C. A. S.

3928. Graphical Enumeration of Results in Gravimetry. F. Breyer. *Beitr. z. angew. Geophys.* 7. 3. pp. 317-336, 1938.—Various methods of deducing results as to gradient and curvature values, gravity, deviation of the plumb-line and potential are discussed and the results compared. The various corrections necessary are reviewed.

C. A. S.

See also Abstracts 4017, 4022, 4023, 4024.

HYDRODYNAMICS AND AERODYNAMICS.

3929. Influence of Vortices upon the Resistance of a Circular Cylinder Moving through a Fluid. S. Tomotika and N. Sugawara. *Phys. Math. Soc. Japan, Proc.* 20. pp. 467-477, June, 1938. *In English*.—The drag due to two symmetrically disposed line vortices in the wake of the cylinder is worked out both by integrating the pressure, and by use of the momentum theorem. The two results agree with one another, and confirm Bickley's result [see Abstract 2050 (1928)].

W. G. B.

3930. Pressure Dependent upon Vortex Formation. A. Donoff. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 5. pp. 365-368, 1938. *In English*.—The two-dimensional flow of an ideal thermally non-conducting gas past a smooth rigid obstacle arranged so that a sudden increase of density of the gas is produced in front of the obstacle is investigated mathematically for the case in which the non-disturbed velocity of the stream is parallel to the axis of abscissæ and exceeds the velocity of sound.

J. S. G. T.

3931. Conical Motion of Ideal Gas in the Case of a Sudden Increase of its Density (Boosemann's Problem). V. Boolinsky. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 5. pp. 369-371, 1938. *In English*.—The general case corresponding to the motion of an ideal thermally non-conducting gas flowing with a velocity exceeding that of sound past a cone having as directrix a special kind of curve corresponding to the cross-section of a thin aerofoil with a sharp leading edge is discussed mathematically.

J. S. G. T.

3932. Chambers for Reducing Pressure Oscillations in Pipes. I. Tcharnyi. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 6-7. pp. 453-458, 1938. *In English*.—A method of calculating the capacity of chambers to be inserted in pipe-lines for reducing pressure surges, taking into account both viscosity and compressibility of the fluid is discussed. Impulsive (hammer) and periodic surges are considered.

J. S. G. T.

3933. Secondary Flow in Straight Pipes. L. Howarth. *Cambridge Phil. Soc., Proc.* 34. pp. 335-344, July, 1938.—By the application of the modified vorticity transfer theory, with Goldstein's assumption as to the tensor $L_i u_j$, it is shown that the condition for secondary flow is that the mixture length is not constant along curves along which $|\text{grad} u|$ is constant, u being the velocity parallel to the pipe axis. Although an investigation of the form of the secondary flow is deferred until further information as to the values of certain constants in the tensor become available, the general form of the stream function indicates that reasonable results are to be expected.

W. G. B.

3934. Fluid Movements Giving a Succession of Applicable Surfaces. H. Pailloux. *Comptes Rendus*, 207. pp. 319-321, Aug. 1, and pp. 389-390, Aug. 17, 1938.

3935. Dispersion of a Turbulent Air Current and the Flow of Underground Water. K. Kitagawa. *Comptes Rendus*, 207. pp. 353-356, Aug. 8, 1938.—Luntz and Japy [see Abstract 2281 (1936)] have shown that the coefficient of turbulence of an air stream can be determined from a single temperature measurement made in the wake of a heated wire placed in the stream. The author shows that a very similar mathematical analysis can be applied to the dispersion of underground water by the sub-soil. R. W. P.

3936. Structural Mechanics of Viscous Elastic Continua. Part II. H. Umstätter. *Kolloid Zeits.* 84. pp. 168-179, Aug., 1938.—Continuing previous work [see Abstract 3015 (1936)], a wave-mechanical theorem of turbulence is derived. It is shown that in consequence of the finite propagation velocity of the tangential disturbances, the separate layers of a spatially extended continuum are effected by the disturbance in a temporary series. In consequence the valid classical relaxation equation must be referred back to such a time-point as the layer in question is removed from the focus of the disturbance. Every lamella has therefore its own time-calculus. In order to obtain a computation of time independent of the system of reference recourse is made to a Lorenz-transformation, and by this relativistic invariant treatment of the Maxwell equation it has been found possible to calculate the distribution of velocity in a spatially extended differential part and to integrate the Newtonian definition equation. The expression thereby obtained affords the theoretical explanation of structural viscosity and anomalous turbulence experimentally determined by Wo. Ostwald. H. H. Ho.

3937. New Method for the Measurement of Gas Flow. R. Duchêne. *Comptes Rendus*, 207. pp. 35-37, July 4, 1938.—The method consists of injecting at one point A of a conduit a small quantity of a gas of a different refractive index, and detecting its arrival at a point B some distance downstream by means of an interferometer. The discharge is determined from the time taken, the length AB, and the sectional area of the conduit. Experiments in a large gas works have shown good agreement with other methods, when applied to a conduit of diameter 1 m. W. G. B.

***3938. Sensitivity of Immersed Venturi-Pitot Head at Low Speeds.** C. Salter. *Phil. Mag.* 26. pp. 272-289, Aug., 1938.—This paper deals with experiments designed to improve the sensitivity of a small-size venturi combined with a total head tube, and to discover whether such an instrument would prove satisfactory as a standard low-speed anemometer. The overall size of the venturi used was not more than about 1 in. in maximum dia. and about 4 in. in length, and the wind speeds were confined to the range 0-10 ft./sec. Full instrumental details are included with 12 appropriate diagrams, and while the experimental data should be useful in other directions, the conclusion was drawn that this particular instrument was not really suitable for use as an accurate standard low-speed anemometer. H. H. Ho.

See also Abstract 4035.

KINETIC THEORY OF MATTER.

3939. Vibration of Molecules in Liquids and its Relation to Viscosity. D. B. MacLeod. *Phys. Soc., Proc.* 50. pp. 788-800, Sept. 1, 1938.—An expression is found for the variation, with temperature, of the average frequency of vibration of a molecule in a liquid. The absolute frequency is calculated approximately and is used in Andrade's expression for the viscosity of a liquid at the melting point, namely, $\eta = \frac{1}{3} \cdot \eta_m / \sigma$, to obtain an expression for the variation of viscosity with temperature. The absolute value of the viscosity is calculated approximately. The internal pressures of several monatomic liquids have been calculated. AUTHOR.

3940. Velocity Distribution in an Atomic Stream and the Free Wave-Length as a Function of Velocity. N. Sasaki and M. Fukuda. *Imp. Acad. Tokyo, Proc.* 14. pp. 166-169, May, 1938. *In German.*—The results are given of an experimental test of the Maxwellian law of velocity distribution and the Tait formula for the free wave-length as a function of the velocity. An atomic stream of Na was formed and the velocity spectrum obtained with a non-homogeneous magnetic field. The intensity distribution was measured with a movable heated tungsten electrometer wire. The results are shown in a diagram. The maximum of the velocity spectrum is almost equally spaced on the two sides of the stream and a secondary maximum due to unmagnetised Na_2 molecules is shown. The theory of the method is given and theoretical and experimental results agree well as shown in a table. R. S. R.

LENGTH, AREA AND VOLUME.

***3941. Radii of Curvature.** K. Giesebart. *A.T.M. No.* 85. V44-6, July, 1938.—An account of the methods of determining radii of curvature, chiefly of lenses, by calculation and by direct and indirect measurement. P. H. B.

3942. Method of Ascertaining and Defining Fineness of Powder. I. Iitaka and R. Shiota. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 811. pp. 897-904, Aug., 1938. *In English.*—The relationship between m the mesh number and d the distance in inches between two adjacent wires in a series of standard sieves is found to be given by the expression $md = 0.579$. This relation may be extended into a finer range of imaginary sieves and the fineness of any powder may be defined by a mesh number calculated from this equation. To determine the fineness of a powder which cannot be separated by actual sieves, a microphotograph of the powder is compared with networks of imaginary sieves, the dimensions of which are calculated from the above equation, at a magnification of 100 dia. W. H. Wal.

***3943. Photoelectric Methods of Metrology.** L. Quevron. *R.G.E.* 44. pp. 265-268, Sept. 3, 1938.—Describes apparatus for the precise measurement of length to, say, 0.1μ by making use of a knife-edge moving across a fine slit through which a beam of light falls on a photo-cell. Other types of measurement, such as angular displacement, diameter of fine wires, evaluation of areas, etc., are dealt with in the later sections of the paper. J. W. T. W.

MASS.

***3944. Electronic Recording Analytical Balance.** R. H. Muller and R. L. Garman. *Indust. and Engin. Chem. (Analytical Edition)*, 10. pp. 436-440, Aug. 15, 1938.—An electronic recording analytical balance

is described which is direct-reading, rapid and sensitive. All mechanical or electrical contactors, relays and the like are dispensed with, inertia- and lag-free electronic methods being employed instead. The time axis is linear and accuracy is assured, as the recorder is driven by a synchronous motor. A choice of speeds is available. The sensitivity is adjustable, so that one division on the record may be set exactly to either 10, 1 or 0.1 mg. This is an electrical adjustment and necessitates no mechanical adjustment of the balance proper. The overall sensitivity is from 20 to 50 times greater than the normal sensitivity of the balance proper, owing to the very precise photoelectric scanning of the pointer, 0.4 mm. displacement of the latter being sufficient to energise the compensating motor. Remote indication and automatic control are inherent features. The instrument utilises standard components, *e.g.*, a magnetically damped chainomatic balance, a recording potentiometer and readily available electronic parts. It should prove of general utility in all investigations involving very slow or very rapid changes of weight or in the study of phenomena which can be followed indirectly by a change of weight. A. W.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

3945. Fundamental Theorem of the Calculus. K. Yosida. *Imp. Acad. Tokyo, Proc.* 14. pp. 211-213, June, 1938. In English.—The construction of all matrix groups continuously homomorphic to the universal covering group $\bar{G}$ of a connected semi-simple Lie group G with s parameters is achieved by the theory of almost periodic functions.

G. C. McV.

3946. Anomalous Case in Cauchy's Problem for the Wave Equation. E. Frola. *Accad. Sci. Torino, Atti*, 73. *Disp.* 3a. pp. 412-427, April-June, 1938.—A function is supposed to be regular and satisfy the wave equation at all times and for a region of space bounded by two parallel planes (or, as a limiting case, in a half-space). Its values for one of the bounding planes and its normal derivative are supposed to be given. It is then proved that, if the function with these properties exist, it is uniquely determined. It does exist, provided the boundary values satisfy certain simple requirements.

R. P.

3947. Operational Solution of the Wave Equation. L. A. Pipes. *Phil. Mag.* 26. pp. 333-340, Sept., 1938.

3948. Wave-Motion for Infinite Domains. A. N. Lowan. *Phil. Mag.* 26. pp. 340-360, Sept., 1938.

3949. Riemannian Tensors. V. V. Narlikar. *Phil. Mag.* 26. pp. 390-394, Sept., 1938.—It is shown how non-null tensors can be represented by vectors with reference to an orthogonal system of basic tensors called R-tensors. The transformation of vectors is discussed and some new inequalities are deduced from the vector representation. AUTHOR.

3950. Operational Forms and Contour Integrals for Bessel Functions with Argument $a\sqrt{t^2-b^2}$ N. W. McLachlan. *Phil. Mag.* 26. pp. 394-408, Sept., 1938.

3951. Generalised Fractional Integration and Differentiation. W. Fabian. *Phil. Mag.* 26. pp. 408-410, Sept., 1938.

3952. Complete Solution of Differential Equation for Confluent Hypergeometric Function. W. J. Archibald. *Phil. Mag.* 26. pp. 415-419, Sept., 1938.

3953. Centres and Foci. I. Koukles. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 6-7. pp. 459-464, 1938. *In French.*—The object of this paper is to study the singular points of the phase plan for the equation: $dy/dx = -F(x, y)/y$ (F being an analytical function), and for the cases where these points are centres or foci. A new method is therefore derived for distinguishing a centre from a focus, which is more effective and useful than the former processes of Bendixon and Frommer, and which allows in certain cases of the existence of a centre to be established by means of a finite number of operations. The paper is entirely mathematical. H. H. Ho.

3954. Comparison of Series of Measures on Different Hypotheses Concerning the Standard Errors. H. Jeffreys. *Roy. Soc., Proc.* 167A. pp. 367-384, Sept. 6, 1938.—A test previously given [see Abstract 1047 (1937)] for the significance of the difference of two means, when the standard errors are unequal, is revised to take account of the uncertainties of the standard errors and of a theoretical complication that has given trouble in other tests. The case where the standard errors can be assumed equal is derived from an existing formula. Some incidental points are discussed and a list is given of tests that have been revised in later work. AUTHOR.

3955. Posterior Probability Distributions of the Ordinary and Intra-Class Correlation Coefficients. H. Jeffreys. *Roy. Soc., Proc.* 167A. pp. 464-483, Sept. 23, 1938.—The posterior probabilities of the ordinary and intra-class correlation coefficients are obtained from an analogy with sampling theory, suggested by the applicability of the normal correlation surface in both cases. The results cast some further light on the relation between direct and inverse methods in problems of estimation; for practical purposes the recommendations made would not differ appreciably. A significance test is obtained for the difference between an intraclass correlation coefficient and zero, and the application to internal correlation in series of measurements is discussed. AUTHOR.

3956. Dimensionless Constants of Physics. A. E. Haas. *Nat. Acad. Sci., Proc.* 24. pp. 274-276, July, 1938.—In addition to four previously-known dimensionless constants a fifth should be introduced, namely the ratio of the total number of neutrons to the total number of protons in the universe. By generalising a formula of Sitte and Glaser [see Abstract 1485 (1934)], it is concluded that in a state of equilibrium the number of neutrons nearly equals the number of protons. They would be exactly equal if the empirical value of $(m_p/m) \times e^2/hc$ were diminished by 0.5% (m_p = mass of proton, m = mass of electron). K. M. C.

See also Abstracts 3963, 4189.

MECHANICS, CLASSICAL.

See Abstract 4036.

MECHANICS, QUANTUM.

3957. Dirac Electron Theory. E. L. Hill and R. Landshoff. *Rev. Modern Physics*, 10. pp. 87-132, April, 1938.—A comprehensive review of the principal properties of the Dirac equation and of its solutions. Starting from the electron spin hypothesis a detailed treatment is given of the non-relativistic theory of Pauli, developed so as to bring out the transition from the Schrödinger to the Dirac equations, and given in a form which is a compromise between the treatment of Pauli and Darwin.

The Dirac relativistic wave equation, with its solutions, applications, and development is then presented. The physical interpretation of the theory, the Dirac positron theory, and the extension of the Dirac equation to two particles are also reviewed. Subsidiary mathematical aspects and methods are given in a series of appendices. N. M. B.

3958. Static Interaction of Charged Particles. C. D. Thomas. *Phys. Rev.* 54. pp. 367-370, Sept. 1, 1938.—The energy of the field due to two charges as described by the field equations of the unquantised Born-Infeld theory is calculated to the first approximation in the case of stationary charges not subject to other external fields. The method of representing the field as the superposition of plane waves in a very large cavity is applied to the field equations expanded in a power series in the constant $1/b^2$ of the Born theory. For the first term this leads to the usual Coulomb energy. The process is then extended to calculate the second term from insertion of the coefficients arising in the first term evaluation. In this case it is found necessary to perform threefold averages in place of the previous single averages, since three of the radiation oscillators describing the field enter into combination. The resulting energy is $e_1 e_2 / r [1 - (1/b^2)(e_1^2 + e_2^2)/8r^4]$. The nature of the series expansion makes the method invalid in the region near 10^{-13} cm. since there the series becomes divergent. AUTHOR.

3959. Spin Phenomena and Boundary Conditions. F. Möglicher. *Zeits. f. Physik*, 110. 1-2. pp. 1-7, 1938.—It is shown that by changing the boundary conditions the directional quantisation of an electron with spin can be described without making use of the Dirac or Pauli matrices. The H problem calculated in this way gives a fine structure formula with integral azimuthal and half integral radial quantum numbers but with the correct multiplicity of eigenfunctions. If certain invariant terms are introduced into the relativistic Gordon wave equation a new wave equation is obtained which for the changed boundary conditions gives the same result as the Dirac equation of the electron. J. E. K.

3960. Final Multiplier and its Validity in Quantum Mechanics. R. Dugas. *J. de Physique et le Radium*, 9. pp. 287-290, July, 1938.—Starting from the interpretation of the final multiplier [see Abstract 1962 (1937)] as a probability density, its expression in wave mechanics and Dirac mechanics is given, defining the corresponding differential systems which play a direct part in the statistical coordination of the old and new mechanics. It is shown that, assuming Planck's law and preserving the Newtonian definition of the state of a system, a discontinuous final multiplier results. The new quantum mechanical definition of state allows the final multiplier to be regularised. N. M. B.

3961. Influence of Radiation on Ionisation Equilibrium. B. N. Srivastava. *Roy. Soc., Proc.* 167A. pp. 484-499, Sept. 23, 1938.—The generalised ionisation formula in the case of thermodynamical equilibrium for an assembly consisting of atoms, ions, electrons and radiation is derived, the particles being supposed to obey any statistics. The ionisation produced in matter has been found for the case when the reaction space is traversed by radiation at a higher temperature. The electrons have been assumed to obey Fermi-Dirac statistics, while the atom and the ion are taken to obey Boltzmann (classical) statistics. The general ionisation formula for this case is derived and two limiting cases discussed. The Woltjer-Milne formula for ionisation in any radiation field is readily obtained as a special case of the general formula. The ionisation formula

for the case when the electrons behave as a degenerate gas is also deduced from the general formula. On substituting the usual expression for the probability of ionisation, *viz.*, $\psi = C\nu^{-3}$, it is found that the ionisation becomes much less when the electrons are highly degenerate. AUTHOR.

3962. Effusion Phenomena in Relativistic Quantum Statistics. B. N. Srivastava. *Roy. Soc., Proc.* 167A. pp. 516-526, Sept. 23, 1938.—The effusion phenomena in non-degenerate and degenerate matter are investigated from relativistic mechanics. Matter obeying either Fermi-Dirac statistics or Bose-Einstein statistics is considered. Non-degenerate matter is first considered, and the number of particles as well as the mass of matter effusing out is calculated. The non-relativistic expressions are obtained as a limiting case. For $f = 10$ the departure from the value for a classical perfect gas amounts only to about 1%. The effusion is then calculated for a degenerate gas, degenerate in the sense of Fermi-Dirac statistics, both to a first approximation and to a second approximation. The non-relativistic formulæ are obtained as a limiting case. In this case it is found that to a first approximation the effusion varies as $p^{\frac{3}{2}}$ and is independent of T , but on working to a second approximation a slight dependence on temperature is observed. The average mass of particles in the effusion stream is calculated. AUTHOR.

See also Abstracts 3883, 3946, 3947, 3948, 4123, 4170, 4216.

PHILOSOPHY OF SCIENTIFIC METHOD.

3963. Logic and Probability in Physics. C. G. Darwin. *Nature*, 142. pp. 381-384, Aug. 27, 1938. *Science*, 88. pp. 155-160, Aug. 19, 1938. *From the Presidential Address to the British Assoc. (Sect. A), Cambridge, Aug., 1938.*—Recent scientific history has revealed a deep schism between professional philosophers and scientists. General philosophy has played no part in the great revolutions of thought of the present century. Each scientist has made some sort of metaphysic for himself. The old logic was devised for a world which was thought to have hard outlines; the method of reasoning must be changed now that the new mechanics has shown that the outlines are not hard. There must exist a wider system of logic having probability as one of its features. The existence of chance is regarded as a blemish; we start prejudiced against probability and in favour of causality. Many are still trying to bring probability within the fold of the old logic; the author does not believe it can be done. The greatest contribution to the subject of probability (in connection with the theory of gases) was made by Gibbs, who made a big assumption quite frankly and without attempt at justification. The subject of probability should play an enormous part in our mathematical-physical education; the study of probability must be incorporated in other subjects.

J. S. G. T.

See also Abstract 4154.

PRESSURE.

See Abstract 3938, and
2852B. Energy Content of Gases at High Pressures. E. W. Geyer.

RELATIVITY AND ETHER.

3964. Light Signals Sent Around a Closed Path. H. E. Ives. *J.O.S.A.* 28. pp. 296-299, Aug., 1938.—In the Sagnac experiment two simultaneously emitted light signals are sent in opposite directions around

a closed optical path, the whole optical system being in rotation about an axis perpendicular to the plane of the apparatus. The results were interpreted as positive evidence for the existence of the ether. The author discusses the modified form of the experiment as performed by Dufour and Prunier [see Abstract 4005 (1937)]. He concludes, in spite of arguments to the contrary [see Abstract 5301 (1937)] that Sagnac's contention remains valid. No consideration of rotation relative to material surrounds is involved; if, and only if, the apparatus rotates with respect to the stars, the observer on the apparatus will observe a Sagnac effect.

J. W. T. W.

See also Abstract 4153.

SOLUTION.

3965. Distribution of RaD(Pb) between Crystals and Solutions of Ba(IO₃)₂. A. Polessitsky. *Acta Physicochimica*, 8. 6. pp. 864-868, 1938. *In English*.—The distribution of RaD between the crystals and solutions of Ba(IO₃)₂ at different temperatures is studied. It is shown that $\Delta\mu$ in accord with Ratner's theory does not vary with temperature [see Abstract 5376 (1933)]. The distribution of RaD between the crystals of Ba(IO₃)₂ and their solutions containing different quantities of Ca(NO₃)₂ is also studied. It is shown that the variation of the partition factor D with the ionic strength of the solution agrees with Ratner's theory. The calculated values of the "true partition factor" D_0 are nearly constant.

AUTHOR.

3966. OsO₄ in CCl₄ Solutions. L. H. Anderson and D. M. Yost. *Am. Chem. Soc., J.* 60. pp. 1822-1825, Aug., 1938.—The distribution ratios of OsO₄ between CCl₄ and water have been measured at 25° for the whole range of concentrations up to saturation and found to vary from $R = N$ (in CCl₄)/ N (in H₂O) = 78 to $R = 136$. The results of solubility measurements are in agreement with the ratio at high concentrations. The vapour pressures of dry CCl₄ above its solutions of OsO₄ were measured at 25° and over the range of concentrations up to saturation. The results do not accord with Raoult's equation. Electron diffraction, spectroscopic and thermal data are used to evaluate the free energies of gaseous, solid and aqueous OsO₄.

AUTHORS.

See also Abstracts 3969, 4140, 4216, 4217.

SURFACE PROPERTIES.

3967. Mechanism of the Adsorption Process. Part I. A New Theory of Adsorption. B. M. Gougouell and E. Ruderman. *Acta Physicochimica*, 8. 6. pp. 795-810, 1938. *In English*.—A new theory of adsorption is proposed, based upon the experimental evidence of fast adsorption with the same high binding energy at low and high temperatures (observed by Roberts) upon the flow of gas through small capillaries, the experimental data and theory of which were given by Clausen, and upon a new "pseudo-desorption" effect observed by the authors. From this theory it follows that the so-called van der Waals' adsorption is a combination of adsorption with high binding energy and condensation, the adsorbed gas forming several layers and the number of these layers varying with the temperature and pressure. This conception of polymolecular layers is in accord with the work of Bradley. Experimental evidence for the "pseudo-desorption" effect is presented together with a description of apparatus and procedure. From the results of preliminary experiments

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it follows that the rate of adsorption is actually the rate at which the gas fills up the inner cracks and spaces existing in the particles of the adsorbent.

AUTHORS.

3968. Retention of Vapours by Active Gels. F. Krczil, F. Schätzler and E. Brixel. *Kolloid Zeits.* 84. pp. 144-149, Aug., 1938.—The amount of benzene retained by a silicic acid and an alumina gel after adsorption and removal of the vapour by blowing air over the gel was determined. In the case of both gels the amount of vapour ultimately retained is independent of the initial amount present, in agreement with the results for activated charcoal.

A. J. M.

3969. Gases and Metals. C. J. Smithells. *Roy. Soc. Arts, J.* 86. pp. 936-949, Aug. 5; 951-964, Aug. 12, and pp. 971-983, Aug. 19, 1938.—The author discusses the behaviour of gases and metals in contact under various conditions, and the laws controlling this behaviour. The subjects discussed comprise, (1) adsorption of gases on metal surfaces, (2) diffusion of gases through solid metals, and (3) solution of gases in metals.

J. S. G. T.

3970. Rate of Adsorption of Gases by Porous Materials. E. Wicke. *Zeits. f. Elektrochem.* 44. pp. 587-590; *Disc.*, 590, Sept., 1938.—An expression for the rates of adsorption and desorption on porous materials is developed, on the assumption that the material possesses a structure consisting of macro-pores of the order of 10^{-4} cm. in size, the walls of which contain micro-pores of the order of 10^{-7} cm. The rate of adsorption of CO_2 at 0°C . and 1 mm. pressure by various samples of active charcoal and of silica gel was investigated. Results obtained for two samples of charcoal support the theory, and lead to a value for the effective diffusion coefficient which agrees well with that obtained directly from measurements of the rate of flow of CO_2 through single granules of the material. In the case of silica gel, and of a third sample of charcoal, active adsorption caused a deviation from the theoretical value. With certain exceptions, the author concludes that the theory is of general validity in so far as purely physical adsorption is concerned.

W. H. Wal.

3971. Adsorption of O_2 by Molten Ag. T. Gerassimoff. *Zeits. f. Elektrochem.* 44. pp. 709-716, Sept., 1938.—Measurements, made by the maximum bubble pressure (Jaeger's) method, of the surface tension of molten Ag in an atmosphere of O_2 show that the dissolved O_2 is capillary-active and is adsorbed by the Ag surface in atomic form. The heat of adsorption is calculated to be 5.2 kg. cal. per $\frac{1}{2}$ mol. O_2 , and agrees approximately with the heat of formation of Ag_2O , 6.7 kg. cal. This can be regarded as evidence that the adsorption of O_2 by the Ag surface is actually a chemical combination.

W. H. Wal.

3972. Adsorption of N_2 and O_2 on W. A. B. van Cleave. *Faraday Soc., Trans.* 34. pp. 1174-1177, Sept., 1938.—The accommodation coefficient of Ne has been used as an indicator to study the adsorption of N_2 and of O_2 on bare W. The rapid adsorption of N_2 at room-temperature observed earlier by a different method has been confirmed and some properties of the second O_2 film, which is formed in addition to the well-known stable film, have been investigated.

AUTHOR.

3973. Sorption of Polar and Non-Polar Gases by Zeolites. R. M. Barrer. *Roy. Soc., Proc.* 167A. pp. 392-420, Sept. 6, 1938.—The sorption equilibria of NH_3 on five zeolites have been studied. The zeolites give sometimes ammoniates and sometimes simple sorption systems, as well as intermediate systems. When dehydration causes

changes in the lattice, ammoniates tend to form; more rigid anionic frameworks of Si-O-Al give sorption systems (chabasite, analcite). The magnitude of the sorption heat bears no relation to the formation of ammoniates. The sorption kinetics of NH_3 by zeolites reveal two types of gas uptake: by diffusion of NH_3 down concentration gradients within the solid; and by diffusion of the phase-boundaries in an ammoniate-dehydrated zeolite. Sorption was rapid for chabasite and analcite (with rigid frameworks) and slow for fibrous and platy zeolites. The thermal treatment in dehydrating the zeolite had a marked influence on the sorption rates in heulandite. The heats of sorption of NH_3 in analcite and chabasite, and on the external surface of natrolite, diminished as the charge of gas increased. The initial values were 30, 23.5, and 12.4 kg.cal. respectively; but the sorption heats decreased somewhat as the temperature was raised. The heat of ammoniate formation in natrolite was 11.7 kg.cal., independent of the amount of ammonia taken up, within limits, and only slightly dependent upon the temperature. The amounts of NH_3 sorbed at saturation approached the theoretical maximum for chabasite and natrolite but were only one-third of this maximum for analcite and heulandite. The saturation maxima decreased linearly with increasing temperature. AUTHOR.

3974. Primary and Secondary Adsorption of Metallic Ions at Metal Surfaces. O. Erbacher. *Zeits. f. phys. Chem.* 182. *Abt.A.* 4. pp. 243-255, 1938.—In continuation of the work of v. Euler who studied the adsorption of Ag at a smooth Au surface in dilute AgNO_3 solution [see Abstract 981 (1923)], the author has investigated the adsorption of Pb at a surface of Ag, Ni or Au, at 20° C. and 79° C., in 0.1 N solution of HCl, using the radioactive isotope ThB as an indicator of the distribution of the Pb between the solution and surface. Metal kations are primarily adsorbed and carry an equivalent mass of ions along with them. The adsorbed mass is found to be independent of temperature only when the concentration of the non-noble metal (Pb) in the solution is so large that more than half the surface of the adsorbing metal is already covered. For smaller concentration the amount of adsorption, in accordance with anticipation, is found to vary with the temperature. A secondary type of adsorption of metal ions is observed when the non-noble metal is incorporated as a small constituent of a complex anion. This effect is studied in the case of the adsorption at 20° C. of Pb and Ag at a Ni surface in 12% HCl solution through which a stream of H_2 flowed. [See following Abstract.] J. S. G. T.

3975. Displacement of Equilibrium by Adsorption of Metal Ions on Pt. O. Erbacher. *Zeits. f. phys. Chem.* 182. *Abt.A.* 4. pp. 256-264, 1938.—By results obtained from the study of the adsorption of Pb from a 12% solution of HCl on a Pt surface bathed with H_2 and either polished or rubbed with emery, it is concluded that the equilibrium of the reaction $[\text{PbCl}_4]^{2-} + 2\text{H}^+ \rightleftharpoons \text{Pb}^{2+} + 4\text{Cl}^- + 2\text{H}^+$ is markedly displaced towards the right due to a primary adsorption of Pb^{2+} ions, although the equilibrium concentration of these ions in the solution is only 10^{-7} . A comparison of the adsorption by both types of surfaces (polished or rubbed with emery), leads to the conclusion that the actively-adsorbing regions are of atomic dimensions. [See preceding Abstract.] J. S. G. T.

3976. Wetting and Corrosion of Metals in Polyphase Systems. Part V. D. I. Mirlis. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 6-7. pp. 483-488, 1938. In English.—On account
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of its hydrophilic nature, Al is more strongly resistant than Fe to corrosion in the benzene and aqueous phases of a system containing fatty acids. On an Al surface activated by a 0.01% solution of corrosive sublimate, a chemically fixed adsorbed layer of the surface active acids is formed, provided no oxide film is present. It is confirmed that the moisture in liquid hydrocarbon fuel is active in producing corrosion, particularly in the presence of an electrolyte, and chiefly stimulates the selective linear corrosion of metals on the three-phase boundary line. Its removal greatly reduces local corrosion. [For Part IV see Abstract 78 (1938).] P. H. B.

3977. Surface Tension by the Ring Method. D. G. Dervichian and C. Clark. *Comptes Rendus*, 207. pp. 277-279, July 25, 1938.—

(1) The calculations of surface tensions from observations by the ring method can be facilitated by means of the empirical relation $\gamma/d = a(P/d) - b$, where γ = surface tension, d = density, P = tension, a is a constant for a particular ring and increases with decreasing ring diameter, and b is roughly constant for all rings. (2) The liquid surface is separated into two parts by the ring. By introducing oleic acid films on to one or other of these parts separately it was verified that the meniscus shapes outside and inside the ring are independent of each other, as assumed in the theoretical treatment by B. B. and H. Z. Freud. P. H. B.

3978. Effect of Temperature on Interfacial Tension between Castor Oil and Water. J. J. Trillat and P. Nardin. *Comptes Rendus*, 207. pp. 291-293, July 25, 1938.—

Measurements of the interfacial tension were made by the ring method, both 2 min. after formation of the interface, and 24 hr. afterwards. Above 45° C. the values are constant and equal. At reduced temperatures the dynamic values fall somewhat but the static values fall much more sharply. Photographic measurement of the position of the ring under the action of a constant tension confirmed these results and showed that the full difference developed in about 8 hr. The results are explained by molecular orientation. At higher temperatures the orientation is opposed by thermal agitation. P. H. B.

3979. Single Crystal Cleavage on Metal Surfaces in High Vacua. W. Kluge. *Phys. Zeits.* 39. pp. 582-585, Aug. 1, 1938.—

A method is described by which single crystal cleavage on metals in high vacua may be produced. The results with Zn are described and the general application of the method to problems in surface physics is indicated. F. C. C.

3980. Structure of Polished Metal Surfaces. E. Plessing. *Phys. Zeits.* 39. pp. 618-620, Aug. 15, 1938.—

The work of Dobinski [see Abstract 1459 (1937)] on polished metal surfaces is repeated using as polishing medium a leather-covered wheel under benzene. Polishing times of 15 hours and longer were employed, and whilst Au and Ag gave results in agreement with those of Dobinski, the positions of the Ni, Cu and Fe haloes agreed with the earlier work of Raether [see Abstract 5440 (1933)]. After heating in a high vacuum, the polished surfaces gave diffraction patterns characteristic of the crystalline metal without a trace of oxide. It is suggested that the difference between Dobinski's results and those of other workers is to be attributed to inadequate polishing of his specimens rather than to the formation of oxide on the polished layers examined by Raether. Insufficiently polished surfaces would give haloes caused by the broadening into one another of the 111 with the 200 and 220 with the 311 diffractions respectively. Comparison of

Dobinski's results with the values to be expected from a very fine grained powder of the corresponding metal gave support for this view. A. G. Q.

3981. Molecular Volumes and Parachors of Mercuric Halides and their Group Relationships. E. B. R. Prideaux and J. R. Jarratt. *Chem. Soc., J.* pp. 1203-1205, Aug., 1938.—Previous work has shown that molar volumes of liquids usually exceed the atomic volumes of their constituents under corresponding conditions, such as equal vapour pressures, the proportionate excess being different for each compound in a series such as the mercuric halides. These differences are mainly due to differences in intermolecular volumes or covolumes, which are controlled by internal pressures. These pressures, identified with van der Waals molecular attractions, a/V^2 , are increased in heteropolar molecules, which have semipolar or polar bonds. The electronic systems of the molecules, through this mechanism, affect all the properties dependent upon covolume and internal pressure, including coefficients of expansion, surface tensions, and parachors. These properties have been evaluated for mercuric, cadmium, and zinc halides. In particular, the parachors of mercuric chloride and bromide have been determined by the method of maximum bubble pressure. Parachors were found to be lower than the sums of the atomic parachors in each case, but a correction for semipolar bonds brings the values into much closer agreement. AUTHORS.

3982. Monolayers of Isomeric Unsaturated Compounds. J. Marsden and E. K. Rideal. *Chem. Soc., J.* pp. 1163-1171, Aug., 1938.—The properties of monolayers of a number of *cis*- and *trans*-unsaturated long-chain acids and alcohols have been examined. Their behaviour suggests that the *trans*-structure can form close-packed films by interlocking, which is impossible in the bent *cis*-form. This view is supported by the examination of mixed films, where it is found that *trans*-unsaturated chains can pack with saturated chains but that the *cis*-form causes expansion. Supplementary evidence is obtained from the oxidation rates of the two isomers in monolayers, which, for the *trans*-isomer, is shown to be very susceptible to compression. The properties of the "*cis*"- and "*trans*"-dihydroxy-acids are of interest in that the *trans*-form produces solid films which can be attributed to hydrogen bonding, suggestive in consideration of filamentous hydroxyl-containing macromolecules. The "*cis*"-dihydroxy-acid appears to be formed almost exclusively on oxidation at interfaces. AUTHORS.

See also Abstracts 3886, 4220, 4222, 4264, 4267, 4268, and 2856B. Transfer of Pressure on Lubricated Cylindrical Surfaces. W. Peppler.

VISCOSITY AND FRICTION.

3983. Viscosity and Density of Aqueous Solutions of Weak Electrolytes at 35° C. M. K. Srinivasan and B. Prasad. *Faraday Soc., Trans.* 34. pp. 1139-1141, Sept., 1938.—For weak electrolytes the Jones and Dole equation is shown to assume the form $\eta/\eta_0 = 1 + A\sqrt{ac} + \beta(1-a)c$, where "*A*" has the customary meaning. The value of "*A*" found experimentally is 0.020 for acetic, 0.03 for salicylic, 0.02 for succinic and 0.00 for benzoic acids. For acetic acid the calculated value is 0.0031 and for the other acids it should be of the same order. In all cases density varies linearly with concentration for dilute solutions. AUTHORS.

3984. Internal Friction of Wood. F. Krüger and E. Rohloff. *Zeits. f. Physik*, 110. 1-2. pp. 58-68, 1938.—The logarithmic decrements
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of transverse oscillations of frequencies $10-700\sim$ and of longitudinal oscillations of frequencies $2,000-10,000\sim$ are determined for pine, maple, Scotch pine and oak. Values of the log. dec. extrapolated to zero amplitude are found to be independent of frequency, for both types of oscillation; this is in agreement with Boltzmann's theory. Values of the log. dec. for the various woods increase in the sequence just stated, that for pine being least. The log. dec. for samples of wood cut transverse to the wood fibres was 3.5 times the value of the log. dec. for samples cut parallel to the fibres. Coating the samples with varnish caused an increase of about 40% in the value of the log. dec.; soaking in water for about 12 hr. caused an increase of about 75% in the value of the log. dec. in one case. The results indicate that pine and maple woods are the most suitable for the construction of resonators in musical instruments. J. S. G. T.

See also Abstract 3939.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***3985. Step of Equatorial Micrometer Screw.** A. Fresa. *Accad. Sci. Torino, Atti*, 73. *Disp.* 3a. pp. 508-518, April-June, 1938.—A report on astronomical observations and their reduction, undertaken to determine, by different methods, the accurate value of the step of the micrometer screw of the equatorial instrument.

***3986. Image-Slicer for Reducing Loss of Light at Slit of Stellar Spectrograph.** I. S. Bowen. *Astrophys. J.* 88. pp. 113-124, Sept., 1938.—The fraction of the light in a stellar image that passes the slit of a spectrograph is calculated, and the limitations on any increase of this fraction by changes in the lens or mirror system are discussed. It is shown that most of this light may be made to pass the slit by means of a device, here described, which slices up the image into a series of strips of a width equal to that of the slit and which arranges them end to end along the slit. The wide spectrum thus produced can be narrowed down by means of a cylindrical lens, thereby increasing the intensity of illumination at the photographic plate by factors ranging up to 10 or more. The aberrations of the cylindrical lens used to narrow the spectrum are discussed. AUTHOR.

COMETS AND METEORS.

3987. Intensity Distribution in the Bands of Cometary Spectra. P. Swings and M. Nicolet. *Astrophys. J.* 88. pp. 173-181, Sept., 1938.—The exceptional intensity distribution of bands of unsymmetrical molecules like CN and CH in comet spectra can be explained by taking into consideration the following factors: (a) the frequency of electronic absorption processes; (b) the distribution in the vibrational levels (ground state) which is a function of the nuclear temperature T_1 or of the equivalent radiation temperature T_λ ; (c) the distribution in the rotational levels corresponding to the nuclear temperature. These factors are different functions of the heliocentric distance r . AUTHORS.

COSMOGONY.

3988. Application of the Velocity-Distance Relation for Spiral Nebulae to Milne's Universe. W. Fricke. *Zeits. f. Astrophysik*, 16. 3. pp. 196-197, 1938.—McVittie has criticised [see Abstract 3582 (1938)] Fricke's arbitrary identification of a theoretical velocity-distance relation in Milne's universe with that observed. Fricke now re-states his belief in the correctness of the identification. G. C. McV.

See also Abstracts 3956, 3993.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

3989. Problem of n Bodies. Y. Hagihara. *Comptes Rendus*, 207. pp. 390-393, Aug. 17, 1938.—The differential equations for the n -body problem can be reduced to a system of equations of order $6n-12$ by elimination of the time t and of the angle defining the line of nodes. In this paper a modification of the reduction process is employed which avoids the explicit appearance of t . A. Hu.

LATITUDE AND LONGITUDE.

3990. Astronomy in Navigation. G. W. Mixter. *Frank. Inst., J.* 226. pp. 133-161, Aug., 1938.—The history of the methods and devices used in finding latitude and longitude at sea from astronomical observations is traced from the earliest times. Changes introduced since 1900 in the interpretation of and methods of utilising the well-known fundamental principles of the subject are attributed mainly to the introduction of Sumner lines, or tangents to the circles of equal altitudes of the navigational bodies. Marcq St. Hilaire's method of plotting Sumner lines by assuming a trial line at the dead-reckoning position and correcting this line by the method of altitude differences is outlined. The methods in present use are illustrated by means of the plotted course of a typical voyage. A. Hu.

NEBULÆ.

3991. Distribution of Galaxies in Northern Milky Way. H. Shapley and R. Jones. *Harvard Coll. Obs., Bull. No. 909*. pp. 1-3, July 1, 1938.—The authors have examined 58 plates taken with the 16-in. Metcalf telescope for outlining the total absorption in low galactic latitude constellations of Perseus, Cassiopeia and Andromeda, the average stellar magnitude being 18.1 with a dispersion of about 0.15. A plot of 9,000 galaxies is given. Seyfert's results are corrected [see Abstract 2462 (1937)]. Hubble's are confirmed, showing that galaxies do not approach the Milky Way, here, in northern latitudes; the "window" being on the south side. In the richest parts of the region surveyed the frequency of galaxies is equal to that in the 1st quadrant of the south galactic cap. A. S. D. M.

3992. Diffuse Nebula NGC 1982 of Orion Group Photographed in Red and Infra-Red Light. J. S. Paraskevopoulos. *Harvard Coll. Obs., Bull. No. 909*. pp. 4-5, July 1, 1938.—Photographs are given exhibiting the striking contrast between red and blue exposures (two are in blue, one in red and one in infra-red) of the small nebula in the Orion group (NGC 1982). This surrounds a fairly bright star, Bond 734, of early spectrum type, B1 (Hubble) or B8 (Cannon) which exhibits "very strong reddening" suggesting "a position within or behind the nebulosity";

raises the question of the depths to which the red-sensitive photographs penetrate in diffuse nebulae; and requires a knowledge of the size and thickness, density and constitution of the diffuse nebulae, which are associated with dark interpenetrating clouds. It is suggested that the apparent separation of the main body of the Orion nebula by a dark passage devoid of stars from the small nebula may be due to a thick black cloud and that the two nebulosities are really one. A. S. D. M.

3993. Metagalactic Density-Gradient. H. Shapley. *Nat. Acad. Sci., Proc.* 24. pp. 282-287, July, 1938.—By counting galaxies to the uniform magnitude limit of 17.9 across the south galactic pole, it is shown that the frequency of galaxies in a direction transverse to the line of sight changes by several hundred per-cent over the region surveyed. It is pointed out that Hubble has used a radial density gradient of 20% between apparent magnitudes 18 and 21.03 to determine the expansion of the universe. Such a gradient is probably an insignificant feature of metagalactic structure, in view of the much larger transverse gradient now revealed. G. C. McV.

3994. Magnitudes of Extra-Galactic Nebulae. G. C. McVittie. *Observatory*, 61. pp. 209-214, Aug., 1938.—The author criticises the forms assumed, in discussing the observations made on the extra-galactic nebulae, for the relation between the red-shift and the apparent photographic magnitude m , on the one hand, and that between m and the number N of nebulae counted in the whole sky down to magnitude m , on the other. General relativity shows that a unique magnitude correction for the dimming effect of the red-shift does not exist, *i.e.*, that the corrections to m are different in the two formulæ. It is therefore concluded that determinations of the structure of the universe by direct comparisons between terms in the empirical and theoretical (N, m) formulæ are untrustworthy, the results thus obtained depending chiefly on the assumed form of the empirical relation. The author's more indirect method is not open to this objection. It shows that a certain class of hyperbolic model universes of large radius represents the observations best. A. Hu.

See also Abstracts 3988, 3995.

STARS.

3995. Theory of Cyclical Transitions. L. G. Henyey. *Astrophys. J.* 88. pp. 133-163, Sept., 1938.—The general theory of cyclical transitions in the absence of collisions is discussed, first for a finite number of discrete states. It is found that the rigorous treatment of the radiation field can be carried conveniently to a fairly advanced state, short of the complete solution of the problem. It is found that there exist a number of first integrals of the differential equations, some of which are generalisations of the constancy of the net flux and of the linear dependence of the radiation pressure on the optical depth in the simple scattering problem. The remaining integrals are simple relationships among the optical depths in the various frequencies. The second part of the discussion is devoted to a study of the properties of the radiation field when the exciting radiation is highly diluted. The approximation appropriate to a high dilution is introduced, and it is found that the problem can be completely solved to within the Milne-Eddington approximation to the directional dependence of the specific intensity. The boundary conditions for a planetary nebula are introduced, and the values of the emergent fluxes are obtained.

Physically the approximation for a high dilution is equivalent to neglecting the transitions corresponding to stimulated emissions and those corresponding to absorption when the lower state is not the ground state. However, these facts do not constitute the basis for the approximation; it is introduced from more fundamental considerations. The last part of the theoretical discussion pertains to the generalisation of the theory to an infinite number of discrete states together with a continuum. This formal extension follows in a natural way and depends on no new physical concepts. Finally there is a section devoted to some computations on the four-state problem for a planetary nebula. One interesting result is the weakness of the (1, 3) radiation ($\text{Ly } \beta$ for hydrogen) when the fourth state is identified with the continuum.

AUTHOR.

3996. Temperature Distribution in Stellar Interiors. G. Tiercy. *Arch. des Sciences*, 20. pp. 123-145, May-June, 1938.—The history of the subject is traced up to the introduction by Bialobrzeski of radiation pressure into the equations of stellar equilibrium, and of the notion of the polytropic nucleus. Thence the author confines himself to the peripheral regions, develops the fundamental equations of radiative equilibrium, and gives an approximate solution for the temperature distribution in these layers. Numerical values are given for a star whose central temperature is 10^7 and whose effective temperature is 5200°C .

A. Hu.

3997. Convective Stability of Stellar Atmospheres Comprised of Doubly Ionised Atoms. Y. Fujita. *Phys. Math. Soc. Japan, Proc.* 20. pp. 484-505, June, 1938.—The effect of convection is considered for the case of a stellar atmosphere in which neutral, singly and doubly ionised atoms of n different gases are present. Generalisation of Chandrasekhar's absorption coefficient to doubly ionised atoms gives $P = \sqrt{2g} \cdot T_0^{9/4} \cdot \sqrt{F}$, where P is the gas pressure and F a function of τ the density. Corresponding to the condition for convection stability one finds for these atmospheres $\frac{1}{\eta} > \frac{1}{3} (4 + 6\tau) \cdot dF/d\tau / F$, where η is a function of the fractions of the various singly and doubly ionised elements present. The H convection zones are calculated numerically for singly and doubly ionised solar atmospheres containing the mixture of atoms given by Russell; it is concluded therefrom that the convection zone appears at $\tau = 2.0$ and reaches to the inner parts of the sun. The life periods of granules and spots are determined from the convective energy transport equation as 2.5 to 4.8 min. and 9 days respectively; these values are in good agreement with observation.

J. E. K.

3998. Density Condensations in Stellar Interiors. Z. Kopal. *Observatory*, 61. pp. 201-208, Aug., 1938.—The internal density concentration in the components of close binary systems is obtainable from their orbital distortions, which give rise to variable longitudes of periastron, observable in some cases, and also from their distortions of form caused by mutual tidal interaction, obtainable from the light-curves. The history of both methods is traced and the surprisingly small condensations yielded are discussed. The possible sources of error in the author's conclusion that the density condensations increase with advancing spectral type are investigated. The inevitable assumption that the structure of both components is the same is the weak point. Chandrasekhar's method depending on the H content of single stars suggests that early-type stars are weakly condensed, whereas with Cepheids the

opposite appears to be the case. At any rate, all methods of approach indicate that the classical models give far too highly-condensed interiors.

A. Hu.

3999. Nuclear Transformations as the Source of Stellar Energy.

G. Gamow. *Zeits. f. Astrophysik*, 16. 3. pp. 113-160, 1938.—The present state of our knowledge of the subject is dealt with under the following heads: general facts of nuclear transformations; velocity of thermal transformations; chain reactions in the nucleus; stellar models based on nuclear transmutations as the energy source; constitution of the nucleus; extremely dense matter in stars; stellar pulsations and explosions. It is concluded that our present knowledge of the properties of matter suffices to begin an attack on the question of stellar evolution; the best hope for the future lies in close collaboration between physicists and astronomers.

A. Hu.

4000. Theorems in Stellar Structure. W. Gleissberg. *Zeits.*

f. Astrophysik, 16. 3. pp. 185-195, 1938.—Inequalities are worked out for a number of integrals which arise in the theory of stellar models in radiative equilibrium.

G. C. McV.

4001. Non-Radial Oscillations of Stars. Part I. C. L. Pekeris.

Astrophys. J. 88. pp. 189-199, Sept., 1938.—In the first part of this paper a derivation is given of the Eulerian equations which govern the small and adiabatic oscillations of a general spherical harmonic type of non-rotating stars. These equations are then solved for a model of constant density. It is shown that with the exception of purely radial oscillations, which are unstable only when $\gamma < 4$, there exist non-radial modes of oscillation, which are unstable for all values of γ . The conclusion is drawn that in the pulsation theory of stellar variability it is necessary to consider non-radial disturbances in order to ascertain the possibility of the existence of any assumed model.

AUTHOR.

4002. Theory of Interstellar Absorption. J. L. Greenstein.

Harvard Coll. Obs., Circ. No. 422. [36 pp.], 1938.—The author discusses the types of interstellar material capable of producing the observed absorption in space and its variation with wave-length. The Mie theory of the scattering of light by small solid particles is used to derive theoretical extinction coefficients for small dielectric and metallic particles. The Oort-Kapteyn theory, providing an upper limit to the density of dark matter in space, is used in conjunction with the classical efficiency factors to compute the extinction coefficients per gm. for electrons, molecules and dust particles as functions of their space density. From these results the optical properties of mixtures of various particle sizes are calculated, using an extrapolation of the observed frequency distribution of hyperbolic meteors. Absorption varying with $1/\lambda$ is exhibited by a mixture of particles of diameters a with a frequency distribution of the form $a^{-3.6}$, the space density of the solid material being about 2×10^{-25} gm./cm³. The effect on the postulated distribution of a possible expulsion of small particles from the galaxy by radiation pressure is investigated. Turbulence caused by encounters with highly luminous stars has probably well mixed the particles of various sizes in space.

A. Hu.

4003. New Spectrum Variable: 5 Lacertae. J. A. Hynek.

Astrophys. J. 88. pp. 201-204, Sept., 1938.—Sharp lines of H and K of Ca II, superposed on the broad H and K lines of the cK5 component of the composite star, 5 Lacertae (K5AOs), are found to vary in intensity

and radial velocity. The velocity of the late star, regarded as constant for many years, is also found to be variable. AUTHOR.

4004. Photometric Observations in Different Colour Regions of the System U Sagittae. K. Walter. *Zeits. f. Astrophysik*, 16. 3. pp. 167-184, 1938.—U Sagittae belongs to the Algol system and consists of a bright small component of early type (B9) and a faint large component of later type (gG2). In a previous investigation the author showed that in such a system the bright component should be spherical but the faint one very elliptically deformed. In order to test this photographic brightness measurements of the variables are made in two different wave-length regions (430 $m\mu$ and 610 $m\mu$) and the normal curves are derived. In accordance with theory the blue light curve is found to be of "Algol type" and the red curve of " β Lyrae type"; the ellipticity of the faint component is quantitatively also in good accord with theory. Both light curves show interesting characteristic detail; the times of the principal minima coincide for both colour regions and the reflection constants are remarkably small. The edge darkening of the gG2 components can be estimated from the depth of the subsidiary minimum. J. E. K.

4005. Hydrogen Band Width in Nova Herculis. E. G. Williams. *Observatory*, 61. pp. 214-216, Aug., 1938.—The observation that the contours of H β , H γ , and H δ in the pre-maximum spectrum of Nova Herculis are dissimilar [see Abstract 3955 (1937)] may be due to instrumental factors. Photographs taken at Mt. Wilson on higher dispersion, however, show the same effect, the agreement in contour being satisfactory. H β is very blunt, and its great width cannot be attributed to blends on the red wing. The difference is therefore real. Post-maximum plates show no such difference. A. Hu.

4006. Bright Line Intensities in Nova Pictoris Spectrum. C. Payne-Gaposchkin and D. H. Menzel. *Harvard Coll. Obs., Circ. No. 428*. [13 pp.], 1938.—An attempt to utilise the unpublished plate material of Nova spectra in many observatories. The method adopted is to use the observed light curve as the fundamental datum and to adjust the intensity scale of each spectrum to fit the observed magnitude of the Nova on the corresponding date, eliminating possible systematic error arising from the failure of the reciprocity law for low intensities of light. The theoretical basis of this is given, with tables and diagrams from the Harvard and Lick plates of Nova Pictoris. All the lines observed show a gradual decline in average intensity; for the same atom they change in similar fashion, but exceptions are given. From the rough parallelism of the intensity lines, the relative intensities can be approximately valued. The continuous background still fluctuated when the starlight was relatively steady and was bound up with the bright-line spectrum. A. S. D. M.

4007. Light-Curves of Cepheids. M. Schwarzschild. *Harvard Coll. Obs., Circ. No. 429*. [7 pp.], 1938.—The difference between Eddington's solution of the differential equation for adiabatic radial pulsations and the author's [see Abstract 1045 (1938)] is illustrated by a hydrodynamical analogy in which the properties of standing and progressive waves are contrasted. It is shown that the radiation flux through a layer of the star's interior is a function of the density of the layer, and thence that in the case of a standing wave the light-variation is affected by the velocity of the material, whilst it is not in the case of a progressive wave. The possibility of explaining the similarity in form and phase between the

light- and velocity-curves of a classical Cepheid by assuming a progressive wave in the outer envelope is therefore explored. The light-curve corresponding to a given velocity-curve on this basis is derived from the energy law, and the laws of continuity, motion, and radiative transfer, and is shown to be of the required form. A. Hu.

4008. Eclipsing Binaries with Apsidal Motion. H. Shapley and H. Swope. *Harvard Coll. Obs., Bull. No. 909. pp. 5-9, July 1, 1938.*—The authors examine Luyten's list of 8 binaries and discuss three systems [see Abstract 3541 (1936)]. For KTCentauri the apsidal rotation must be exceedingly slow; for GN Normae, it must be more than a thousand years; and for YY Sagittarii it is not less than 300 years, and here the data might even suggest a regressing line of apsides. A. S. D. M.

4009. Observations by American Association of Variable Star Observers. L. Campbell. *Harvard Coll. Obs., Ann. 107. 1. pp. 3-41, 1938.* [See also Abstract 3157 (1938).]

4010. Reduction of Visual Catalogues to the Harvard Photovisual System. C. Payne-Gaposchkin. *Harvard Coll. Obs., Ann. 89. 12. pp. 191-199, 1938.*—A reduction of the magnitudes of 40,000 stars to the Harvard photovisual system has been completed. It is shown that the mean errors of the average magnitudes have been significantly reduced by the systematic corrections that have been applied to the original magnitudes. A catalogue of the magnitudes of stars north of $+80^\circ$ is given, and the Harvard magnitudes are shown to have a very small accidental error by comparison with the catalogues of the same stars published by the Mount Wilson and Leiden observatories. The relation between the Harvard and the International photovisual systems is determined to be: $IP_v - HP_v = +0.10 + 0.06 C_r$. The colour excesses for stars of early type north of $+80^\circ$ are shown to be related to the presence of obscuration detected by other means. AUTHOR.

See also Abstract 3961.

SUN.

4011. Ionospheric Eclipse of 1940, Oct. 1. *Roy. Astron. Soc., M.N. 98. pp. 664-669, June, 1938.*—Projections on the earth of the paths of totality, for the optical eclipse at heights of 100 and 300 km. above the earth's surface, are given for those land regions where observations may be made during the 1940 solar eclipse, viz., in S. Africa and S. America. The results, presented in the forms of maps and tables, give the central line and the northern and southern limits of the track at frequent intervals of time, the geographical coordinates being accurate to $1'$. J. P. A.

4012. Fraunhofer Intensities in the Infra-Red Region. C. W. Allen. *Mt. Wilson Observat., Contrib. No. 594. Astrophys. J. 88. pp. 125-132, Sept., 1938.*—Equivalent breadths, measured photometrically on spectra taken with an 18-ft. focus spectrograph at Mount Wilson Observatory, are tabulated for 188 absorption lines in the solar spectra between 8800 and 11830 Å. AUTHOR.

4013. Analysis of Infra-Red Limit of Atmospheric Transmission. A. Adel and C. O. Lampland. *Astrophys. J. 88. pp. 182-185, Sept., 1938.*—The correspondence between the related set of CO_2 bands at $15\ \mu$ and the infra-red limit of atmospheric transmission is discussed in detail. A sample curve of atmospheric transmission in this spectral region is given by way of illustration of the detail actually present

in what had formerly been considered a featureless, smooth curve. [See also Abstract 1554 (1938) and following Abstract.] AUTHORS.

4014. Rock-Salt Prismatic Solar Spectrum. A. Adel. *Astrophys. J.* 88. pp. 186-188, Sept., 1938.—New features in the infra-red telluric spectrum, made apparent with increased resolving-power, are briefly discussed. [See preceding and following Abstracts.] AUTHOR.

4015. Origin of Infra-Red Telluric Absorption Band q_2 . A. Adel. *Astrophys. J.* 88. pp. 200-201, Sept., 1938.—It is demonstrated that the telluric absorption band at 12.65μ is a member of the family of CO_2 bands which determine the infra-red limit of atmospheric transmission. AUTHOR.

See also Abstracts 4035, 4046.

ZODIACAL LIGHT AND GEGENSCHIN.

4016. Galactic Matter and the Zodiacal Light. B. Fessenkoff. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 6-7. pp. 451-452, 1938. *In French.*—It is assumed that a stream of particles, moving within the galaxy in parallel straight lines with uniform velocity, is deflected by the gravitational attraction of the sun. The brightness of the sky in the east and in the west due to this cause is calculated and an observational check on the theory is indicated. G. C. McV.

GEOPHYSICS.

GEODESY.

4017. Gravity Reductions and the Figure of the Earth. B. L. Gulatee. *Gerlands Beitr. z. Geophys.* 53. 4. pp. 323-336, 1938. *In English.*—The accuracy of the various formulæ for deducing the rise of the natural geoid with respect to its reference spheroid from the gravity anomalies is considered. The merits and demerits of the various reductions for reducing observed gravity from ground level to geoidal level for the above purpose are discussed. AUTHOR.

GEOPHYSICS, APPLIED.

***4018. Tests of Small Surveying Theodolites with Helical Gearing and Measuring Spindle.** K. Lüdemann. *Zeits. f. Instrumentenk.* 58. pp. 279-286, July, 1938.—Details are given of the structure and use of two small types of Hildebrand instruments. The efficiency of the instruments on the test bench and in the field has been confirmed and results are quoted showing the degree of accuracy attainable. R. S. R.

See also Abstracts 4026, 4257.

HYDROSPHERE, PHYSICS OF THE.

***4019. Oceanographic Current Recorder.** H. Dahl and O. Dahl. *Rev. Sci. Instruments*, 9. pp. 243-245, Aug., 1938.—A full description of the recorder which is of the propeller type is given along with line diagrams. A vane maintains the instrument against the current while the use of the diving bell principle ensures that water sensitive

parts are protected. The direction of the current is determined by measurement of the variation of electrical resistances. An amplifier which is of the d.c. type, operates the counting device. The amplifier is described in detail, and the description accompanied by a diagram.

A. E. M. G.

4020. Drift of Ice-Fields. W. W. Shoulejkin. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 8. pp. 589-594, 1938. *In English*.—The theory relating ice drift velocity (u) to wind velocity (V) is established. It is found that when V is slight u/V tends to zero, but as V increases, u/V increases rapidly and then more slowly as the angle between the two directions approaches a limit. The results are compared with the motion of the Soviet Polar Drift Station. In the whole drift no traces are discovered of currents of non-drift origin. The East Greenland current is thus purely of drift origin caused by ice movement and this in turn set up by the monsoonal type of winds off the Greenland coast.

R. S. R.

4021. Horizontal Mixing of Water Masses of the Caspian Sea. W. Stockmann. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 8. pp. 565-568, 1938. *In German*.—Observations of salt content, S , and temperature, t , for different depths made over the central and southern parts of the Caspian Sea in 1933-37 were analysed. A series of S - t curves were constructed to locate the various mixing regions. Layers of maximum and minimum stability were found, the latter predominating. Horizontal turbulence plays an important part in the mixing processes and with vertical stability there is an increase of horizontal mixing. The mixing processes indicate an ellipsoid with its minor axis parallel to the isopycnic surfaces.

R. S. R.

LAND, PHYSICS OF THE.

4022. Magnetic Anomalies and Subterranean Structure. T. Nagata. *Imp. Acad. Tokyo, Proc.* 14. pp. 176-181, May, 1938. *In English*.—Tsuboi's relation [see following Abstract] of gravitational potential to magnetic distribution is connected with Poisson's relation of magnetic to gravitational potential to obtain the magnetic intensity distribution along the subterranean mass directly from magnetic observations on the earth's surface. Examples are given of the application of the method to the analysis of magnetic anomalies. The theory gives results agreeing well with experimental values obtained by boring at Kursk.

R. S. R.

4023. Gravity Anomalies and Subterranean Mass Distributions. C. Tsuboi. *Imp. Acad. Tokyo, Proc.* 14. pp. 170-175, May, 1938. *In English*.—The subterranean mass distribution can be determined approximately from the corresponding gravity values by assuming that the mass distribution can be replaced by that concentrated on the subterranean plane situated at the average depth of the boundary of different densities. The theory of the method is given. Examples are given of its application to (1) Eötvös relation of gravity gradients and subterranean mass distribution, (2) Meinesz's gravity measurements in the East Indies, (3) surface topographic relief and Bouguer anomalies, and (4) Bullard's gravity measurements in the African rift. [See following Abstract.] R. S. R.

4024. Gravity Anomalies and Subterranean Mass Distribution. Part II. C. Tsuboi and T. Fuchida. *Tokyo Univ. Earthquake Research Inst., Bull.* 16. pp. 273-284, June, 1938. *In English*.—Previous work
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[see Abstract 5207 (1937)] is extended from a two-dimensional to a three-dimensional distribution of gravity anomalies by an application of the potential theory. [See also preceding Abstract.] W. A. R.

4025. Structure of the Earth. S. v. Bubnoff. *Naturwiss.* 26. pp. 490-493, July 29, 1938.—Reference is made first to Kossmat's view that the N. pole lies in a bay surrounded by old continents while the S. pole lies in an old, earlier solidified, block of the Antarctic. The growth of the northern continent (Europe, Asia, America) has been by sliding along lines of folding with cores over Canada, Scandinavia and Finland, and East Siberia, while the southern continent has broken up along the lines of the Atlantic and Indian Oceans. Climatic and geological evidence in support of these views is discussed. The views lead to the idea of the whole earth's surface acting as a quasi-homogeneous region of deformation. The relation of these views to Wegener's continental drift theory are examined. R. S. R.

4026. Structure of the Earth as Revealed by Seismology. E. A. Hodgson. *Roy. Astron. Soc. Canada, J.* 32. pp. 273-298, July-Aug., 1938.—After introductory remarks on earthquake zones, seismographs, and types of waves the refraction method to determine the thickness of the earth's crust is explained. The time-distance graph used to get velocities at any depth in the mantle is considered next and particularly the Herglotz-Wiechert method. Information relating to the core is largely incomplete for reasons given. Lastly the use of the reflection method for a survey of the upper crust in locating oil-bearing layers is discussed. R. S. R.

4027. Gravitational Stability of the Earth at its Liquid Cooling Stage. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 16. pp. 234-243, June, 1938. *In English.*—The stability of the earth would depend upon the size of any masses which have cooled, become denser, and sunk. A pear-shaped, ellipsoidal, or even a tetragonal deformation in a past liquid state of the earth is possible. [See following Abstract.] W. A. R.

4028. Effect of Cooling on a Plastic Earth under Gravitational Forces. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 16. pp. 244-255, June, 1938. *In English.*—The effect of cooling of any layer on the plastic deformation of the earth under gravitational forces is small. Cracking is not likely to occur, or to be very marked, unless the earth is incompressible in the earliest stage of consolidation. [See preceding Abstract.] W. A. R.

4029. Ground Movement in Mines. H. P. Greenwald. *J. of Applied Physics*, 9. pp. 567-572, Sept., 1938.—The compression tests of blocks of potash-bearing salt indicated that load on mine pillars composed thereof should not be much more than 2,000 lb./in². when these pillars are expected to stand a considerable number of years. So long as the roof strata remain unbroken, there is little likelihood of shearing along the edges of pillars. Apparently the immediate roof stratum is sufficiently thick to permit development of the arch-shaped crack without having this crack reach the top of the stratum. It is a crack of this nature that should be looked for as a first indication that the roof is overloaded. The observed behaviour of these materials, which results in large part from their plastic properties is of great practical importance as it is possible to devise methods of mining by which practically all of the valuable potash-bearing salt can be recovered without breaking the roof. Instead,

the roof can be made to subside gradually into the area from which the potash-bearing salt has been removed. [See also Abstract 3964 (1937).]

AUTHOR.

4030. Normal to Tangential Viscosity Ratio and Poisson's Ratio in Soils. K. Iida. *Tokyo Univ. Earthquake Research Inst., Bull.* 16. pp. 391-406, June, 1938. In English.—Experiments are described showing the relations between the normal (γ_e) and tangential (γ_t) coefficients of solid viscosity, Young's modulus (E), the modulus of rigidity (μ) and the water content of the soils previously examined [see Abstract 2483 (1937)]. All four diminish rapidly with increased water content, while the Poisson ratio and $m [= (E/\mu)/(\gamma_e/\gamma_t)]$ increase therewith; λ^1/μ^1 (where λ^1 and μ^1 are viscous coefficients similar to Lamé's constants λ and μ) assume an increasing negative value as the water content increases, the soil behaving more and more like a viscous fluid.

C. A. S.

4031. Grain Structure and Water Content of Sand Dunes. R. A. Bagnold. *Nature*, 142. pp. 403-404, Aug. 27, 1938.—Two types of sand accumulation are distinguished (1) encroachment due to sand accumulating on the upper sheltered part of the slope thus increasing the angle of shear until an avalanche occurs, and (2) accretion due to layers formed parallel to the surface exposed to the wind. The former is soft and has a loose packing but the latter is firm and the grains are close and orderly. With the former rain seeps rapidly to depths where temperature and evaporation have no effect but with the latter there is lateral spreading of the water and rapid evaporation.

R. S. R.

See also Abstract 3935.

METEOROLOGY.

4032. Radiation Properties of the Snow-Cover. C. Thams. *Gerlands Beitr. z. Geophys.* 53. 4. pp. 371-388, 1938.—A report is given of researches upon the radiation properties of the snow-cover. These investigations consist mainly of measurements of the reflection power as well as of the absorption power. The albedo (reflection power) of new snow is on the average 0.82, for old snow it goes down to 0.60 and for melting snow to 0.50. The records of the snow albedo show sensible alterations in the course of days and even hours. The measurements of the transmission have given as result a mean value of 0.083 for the absorption coefficient of the snow-cover. By means of a few examples it is shown to what extent radiation energy falls upon the snow-cover, is reflected by the surface and absorbed by the various layers of snow in the different winter months.

AUTHOR.

4033. Atmospheric Soundings by Luminous Rays. Part II. J. Duclaux. *J. de Physique et le Radium*, 9. pp. 259-261, June, 1938.—The method [see Abstract 5064 (1936)] has been further developed by using a high pressure mercury-vapour lamp at the focus of a parabolic mirror. Exposures of 1 hr. are considered satisfactory. The beam divergence has been reduced to 0.2 in 100 and further reduction is desirable. Panchromatic plates are less satisfactory than ordinary plates with a filter passing 3600 to 4400Å.

G. C. E.

***4034. Upper Air Investigations and Radio Meteorographs.** R. R. Bajpai. *Science and Culture*, 4. pp. 6-14, July, 1938.—After referring to earlier methods of upper air investigation and generally

indicating the several faults from which these various methods suffered the author proceeds to discuss the radio meteorometric equipment. This equipment is furnished with instruments to measure the meteorological elements at certain points and to transmit the measurements to a conveniently situated station. Two main types of instrument are in use, the constant and the variable frequency meteorograph. A full description of each type is given. Two examples of each kind are considered and a detailed account given of the methods of recording. The paper is illustrated by a number of diagrams and photographic reproductions.

A. E. M. G.

4035. Application of Line Integral Theorems of Hydrodynamics to Terrestrial and Cosmical Vortices. H. Philipps. *Naturwiss.* 26. pp. 457-460, July 15, 1938.—Shows how the results of v. Bjerknes concerning the kinematic and dynamic circulations explain certain phenomena connected with land and sea breezes, the general circulation of the atmosphere, and sunspots.

W. G. B.

4036. Vertical and Horizontal Interchange in the Light of the Problem of Motion of Projectiles. H. Arakawa. *Gerlands Beitr. z. Geophys.* 53. 4. pp. 273-276, 1938.—The motion of a small air particle in the gravitational field of the earth is calculated. With the help of the problem of projectile motion it is shown that (1) horizontally the lateral mixing is essentially operative as in the vertical, (2) the smaller the temperature decrease with height in the atmosphere the greater is the lateral mixing and the smaller the vertical mixing, (3) in labile air masses the disturbance limits itself to small regions such as showers and fronts, and (4) if the air is in moist labile layers the increase of height of the projectile track is sufficient to bring about an interchange.

R. S. R.

4037. Tropical Cyclones. E. Gherzi. *Gerlands Beitr. z. Geophys.* 53. 4. pp. 316-322, 1938. *In English.*—The paper contains criticisms on articles published by different authors on the nature of tropical cyclones. Some of the points considered are, the conditions in, and cause of a typhoon and the origin of the air masses within it, certain characteristics, e.g., the "dangerous semi-circle," the escape of air from the cyclone and its direction of motion.

A. E. M. G.

4038. Colour of the Night Sky. R. Grandmontagne. *Comptes Rendus*, 207. pp. 275-277, July 25, 1938.—Observations of the energy distribution in the spectrum of the night sky have been made with a self-registering photoelectric photometer. The photo-cell used has a maximum sensitivity at 6200 Å and is relatively insensitive beyond 8000 Å; it is calibrated against a comparison source consisting of a tungsten lamp operated at 2100° K. The spectral regions in which measurements are made are isolated by means of filters with cut-offs below 5800, 6550, and 7000 Å respectively. The curve given shows a maximum from 7000 to 9000 Å separated by a minimum around 6800 Å from a second lower peak at 6100 Å. The energy is very low in the blue and violet. The measurements are means of observations made over 4 months: diurnal and annual variations are therefore smoothed out [see following Abstract].

A. Hu.

4039. Annual Variations in the Colour of the Night Sky. R. Grandmontagne. *Comptes Rendus*, 207. pp. 321-323, Aug. 1, 1938.—Observations similar to those previously described [see preceding Abstract] have been made on all clear nights free from mist and moonlight from May, 1937, to April, 1938, inclusive. The energy in the region 5800-9000 Å is plotted against epoch. Three maxima are shown: one in Nov. corresponds to the autumnal equinox.

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ponding to that found by Rayleigh and Spencer Jones [see Abstract 3815 (1935)]; another smaller one in Mar. not taken into account by Rayleigh and Spencer Jones in representing their results analytically, but shown by their individual observations and by those of Cabannes and Dufay [see Abstract 2031 (1935)] on the Vegard-Kaplan bands; and a third in June and July which is attributed to solar twilight. A slight phase difference between the author's results and those of Rayleigh and Spencer Jones is attributed to the slightly shorter mean wave-length used by the latter. It is suggested that for purposes of observation of the night sky, astronomical twilight should be used (sun 18° below horizon). A. Hu.

4040. Intensity of the Green Ray of the Night Sky. N. Wassmuth, V. Werzner, S. Tibilov and S. Freivert. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 5. pp. 405-407, 1938. In French.—Measurements made in 1934 indicated a variation in the intensity of the green ray of the night sky, a maximum appearing between 1h. and 2h. 30m. In 1937 this work was continued, the object being to determine more accurately the position of the maximum. A schematic drawing of the photometer used is given and curves represent the results obtained during 5 nights in August. The observations were made as before at a height of 3000 m. ($43^\circ 17' \text{ N.}$, $42^\circ 28' \text{ E.}$). The curves confirm the existence of a maximum with its value changing from day to day. The position also varies with time just as the 1934 work showed. This variation was confirmed by several observers making simultaneous observations independently. A. E. M. G.

4041. Atmospheric Absorption. T. Kiu. *J. de Physique et le Radium*, 9. pp. 297-307, July, 1938.—The author seeks to represent by a straight line $D = A + Bf(\lambda)$, where $f(\lambda) = (\mu_o^2 - 1)^2 \lambda^{-4}$, the optical density of the atmosphere at the zenith according to the measurements made by the Smithsonian Institution at Montezuma, Chili (altitude 2711 m., latitude $22^\circ 40' \text{ S.}$) from 1920 to 1930. A distinct correlation is found between the height of precipitable water and the constants A and B. For dry air, calculation of Avogadro's number gives a value of $(6.136 \pm 0.085) \cdot 10^{23}$, which is closer to that of Millikan than values previously deduced from molecular diffusion observations. The seasonal variation of the constant A is studied and calculations made of the thickness of O_3 present each day in the atmosphere. The coefficient of absorption found by Vassy for the visible spectrum, corrected for temperature, gives results for O_3 thickness in perfect agreement with those obtained from the u.v. measurements made at Montezuma. A. W.

4042. Atmospheric Light and Visibility. H. Koschmieder. *Naturwiss.* 26. pp. 521-528, Aug. 12, 1938.—After preliminary remarks on the essential questions involved relating to day and night visibility a general formula is developed for the light of any colour reaching the eye direct from the source, and by scattering, under certain limiting conditions. Measurements carried out over, and near to, the Baltic for distances 1-4 km. show the importance of the albedo of the object reviewed, its position relative to the sun, and variations in different directions due to pollution by town smoke. Expressions are next obtained relating the atmospheric light to the distance between object and observer. This leads to the equation $h_s/h_h = 1 - e^{-3.912l/s}$, where h_s is the apparent brightness of the surface, h_h the horizontal brightness, l the distance away of the object, and s the visibility distance. Bennett's results and

Foitzik's comments on them are discussed. Finally the various factors are reviewed and comments made on the use of various visibility meters.

R. S. R.

4043. Sodium in the Upper Atmosphere. J. Cabannes, J. Dufay, and J. Gauzit. *Astrophys. J.* 88. pp. 164-172, Sept., 1938.—Spectroscopic and interferometer observations show conclusively that the bright yellow radiation of the night sky coincides with the two D lines and that Na atoms are always present in the upper atmosphere. At twilight the yellow radiation is increased, like the red line λ 6300 of [O1]. The writers are examining the altitude of the luminescent layer and the origin of atmospheric Na; they believe that the Na comes from meteorites. [See also Abstract 3177 (1938).]

AUTHORS.

4044. Interpretation of Aurora-Spectrum. J. Kaplan. *Zeits. f. Physik*, 109. 11-12. pp. 744-749, 1938. Vegard and his collaborators have ascribed certain bands of the aurora spectrum to $A^3\Sigma \rightarrow X'\Sigma$ transitions in nitrogen. The author shows that eight of these assignments are wrong, and that the aurora spectrum is not identical with the ϵ -system of solid nitrogen. He proposes to differentiate between the bands of solid and gaseous nitrogen by using the denotations " $A^3\Sigma \rightarrow X'\Sigma$ (solid)" and " $A^3\Sigma \rightarrow X'\Sigma$ (gaseous)" respectively.

L. K.

4045. Production of Aurora Spectrum in the Laboratory. J. Kaplan. *Zeits. f. Physik*, 109. 11-12. pp. 750-752, 1938.—The author describes the characteristic aurora afterglow which he has obtained in his discharge tube. The discharge shows a blue-white colour and the afterglow is a pronounced blue in contrast to the yellow colour of the ordinary afterglow of N_2 . Two photographs are reproduced showing the spectra of the aurora-afterglow obtained in a discharge tube and of an ordinary discharge.

L. K.

4046. Halo Phenomena and Solar Activity. G. Archenhold. *Gerlands Beitr. z. Geophys.* 53. 4. pp. 395-475, 1938.—Observations of haloes over the years 1926-36 are given and typical properties of halo statistics treated, especially annual variation and the grouping of halo days. A method of elimination of the annual variation based on peculiarities of the frequency distribution is given. Comparing monthly values for an individual year high halo numbers are correlated with high sunspot relative numbers, while for a whole sunspot period the effect may be diminished or inverted. Correlation of monthly numbers of sunspot activity and magnetic character figures becomes closer if systematic differences are eliminated. Based on 73 years of observations the periodicity of 27 to 28 days, due to solar rotation is found in the appearance of haloes. It may be possible to connect active regions on the sun with individual haloes when more observations of chromospheric eruptions are available. The physical nature of the influence of solar activity on halo frequency is discussed.

R. S. R.

See also Abstracts 4013, 4014, 4015, 4224.

SEISMOLOGY.

4047. Seismic Waves Due to Traction Applied to the Inner Surface of a Spherical Cavity in an Elastic Earth. G. Nishimura and T. Takayama. *Tokyo Univ. Earthquake Research Inst., Bull.* 16. pp. 317-354, June, 1938. In English.—Continuing previous work [see Abstract 5289 (1937)] the authors show that, when shock stresses are applied to a cavity, both longitudinal and transverse waves are excited.

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Each is composed of free, forced and complementary waves. The forced waves have the same frequency as the applied stresses; the free waves are damped simple-harmonic vibrations, whilst the complementary waves are of an aperiodic decaying character. At some distance from the cavity longitudinal waves excite only the radial vibrations of particles, whilst the transverse waves excite only the co-latitudinal and azimuthal vibrations of the same particles.

W. A. R.

4048. Anomalous Dispersion of Rayleigh Waves. K. Sezawa and K. Kanai. *Imp. Acad. Tokyo, Proc.* 14. pp. 246-249, July, 1938.—The calculations in a previous paper [see Abstract 3627 (1938)] dealt with a special case of anomalous dispersion of Rayleigh waves. To obtain the general features of the problem calculations were extended to six widely different cases and the results are shown graphically and discussed. The nature of the velocity equation obtained three years earlier is rediscussed from a more analytical point of view.

R. S. R.

4049. Seasonal Distribution of Earthquakes. S. Yamaguti. *Tokyo Univ. Earthquake Research Inst., Bull.* 16. pp. 355-365, June, 1938. *In English.*—The earth between 60° N. and 50° S. is divided up into areas 30° × 30°, and each area is numbered 1, 2, 3, and 4, according as the maximum number of earthquakes recorded in Bellamy's Catalogue of earthquakes in 1913-30 occurred in March-May, June-Aug., Sept.-Oct., or Dec.-Feb. The numbers of earthquakes in season 2 exceeds, that in 4 is below the average, but there is entire irregularity in distribution of the areas.

C. A. S.

***4050. Kreis-Wanner Seismograph.** P. L. Mercanton. *Comptes Rendus*, 207. pp. 374-375, Aug. 8, 1938.—A detailed description is given of a new vertical seismograph which has been installed at Degenried-Zurich to replace the Wiechert apparatus. With an amplification of 150 times the period is 10 sec. The stationary mass is 1100 kg. An electrical method is used to compensate for temperature. The registrations obtained are remarkably good and Rayleigh and Love waves are easily recognised.

R. S. R.

See also Abstracts 4026, 4027, 4028.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

4051. Phase Irregularities of the Diurnal Component of the Earth's Electric Field. R. Guizonnier. *Comptes Rendus*, 207. pp. 372-374, Aug. 8, and pp. 403-404, Aug. 17, 1938.—Graphs have been made connecting longitude and the hour of maximum of the diurnal component for a pronounced perturbation using local and Greenwich time. The abnormal diurnal component is the resultant of the normal diurnal component and a semi-diurnal perturbation which is accentuated for five observatories but less marked for others. Each ordinate of the semi-diurnal component was combined with the two preceding and the two following at 6- and 12-hour intervals, to get mean values. The results are shown graphically and the amplitude of the maximum for the semi-diurnal component is accentuated. Tests with curves for Kakioka, Christchurch and Colorado confirm this view. Such a semi-diurnal variation suffices to explain the abnormal phase of the diurnal component of the earth's electric field given by analysis. [See Abstract 2037 (1935).]

R. S. R.

See also Abstracts 4022, 4080, 4224.

RADIOACTIVITY.

4052. Highly Activated Atomic Nuclei. L. Goldstein. *J. de Physique et de Radium*, 9. pp. 262-272, June, 1938.—The statistical model is used to investigate the dissipation of high energy levels. Assuming strong coupling between the particles in the nucleus it is shown that the simultaneous emission of several heavy elementary particles is plausible. Rupture of the nucleus into complex fragments is improbable. Reasons are given for believing that the statistical magnitudes obtained approximate to the real values. Critical excitation energies are found for different bands, and the way in which energy is dissipated from the latter varies from band to band. It is concluded that laboratory excitation of nuclei has so far only provoked successive and not simultaneous emission. Cosmic rays can lead to shower production, the neutron-proton composition of which depends on the atomic number. G. C. E.

4053. Nuclear Excitation and Partitio Numerorum. K. Umeda. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers*, No. 794. pp. 629-636, June, 1938. *In German*.—By use of the *partitio numerorum* it is shown that the expected mean number of particles excited in a nucleus should be the $2/3$ power of the maximum number. The mathematical analogy suggests a system consisting of an unlimited number of Bose particles, the characteristic frequencies of which are the same. G. C. E.

4054. Theory of Radioactivity, Natural and Artificial, Based on Nuclear Constitution. A. Véronnet. *Comptes Rendus*, 207. pp. 121-123, July 11, 1938.—Denoting a proton by P, neutron by N, deuteron by D, and triton by T, D is composed of $P + N$, T of $D + N$, or $P + 2N$; and the general expression for the nucleus zA , where z is the atomic number, reduces to $zA = (3z - A)D + (A - 2z)T$. Radioactivity is explained as the result of the decomposition $2T \rightarrow \alpha + \beta + D$, or $4T \rightarrow 2\alpha + 2\beta + 2D \rightarrow 3\alpha + 2\beta$. C. A. S.

4055. Resonance Levels of Nitrogen Excited by Rapid Neutrons. J. Thibaud and P. Comparat. *Comptes Rendus*, 206. pp. 226-228, July 18, 1938.—The numbers of α -particles thus ejected [see Abstract 3632 (1938)] are plotted against the energies $E_{\alpha+B}$. The curve thus obtained shows eleven maxima indicating resonance levels for $E_{\alpha+B} = 0.85, 1.02, 1.30, 1.60, 1.75, 2.05, 2.25, 2.55, 2.75, 3.05$, and 3.30×10^6 eV; these results agree fairly well with those of Wilhelmy [see Abstract 602 (1938)], but are somewhat more detailed and more extensive. C. A. S.

4056. Angular Distribution of Resonance Disintegration Products. R. D. Myers. *Phys. Rev.* 54. pp. 361-367, Sept. 1, 1938.—For resonance symmetry considerations alone are found to give definite results on the angular distribution of the products of nuclear reactions. Formulæ are developed for general coupling and Russell-Saunders coupling. It is found that the distribution is axially symmetric about the direction of the incident particle. It is also symmetric about the equatorial plane. The expression for the distribution is usually restricted to a small number of terms in an expression in spherical harmonics. These results are applied to the reactions: $D^2 + D^2 \rightarrow H^3 + H^1$; $B^{11} + H^1 \rightarrow Be^8 + He^4$, $Li^7 + H^1 \rightarrow 2He^4$, and $Li^6 + H^2 \rightarrow Li^7 + H^1$. For Russell-Saunders coupling the distribution for these reactions is uniquely determined by the assignment of the quantum number to the states involved. AUTHOR.

4057. Radioactive Cd. M. Dodé and B. Pontecorvo. *Comptes Rendus*, 207. pp. 287-289, July 25, 1938.—A description is given of radioactivity induced in Cd by bombardment with fast neutrons. The radiation emitted is very absorbable. It is suggested that the active element is an isotope of Cd; and that the radiation of low energy is emitted on decay of the excited nucleus through a metastable state. G. O. B.

4058. Radio-Silicon Produced by Bombardment of Sulphur with Rapid Neutrons. J. Cichocki and A. Soltan. *Comptes Rendus*, 207. pp. 423-425, Aug. 22, 1938.—Bombardment of S with neutrons of energy 13.5×10^6 eV produced by bombardment of Li with deuterons of energy 430 ekV, gives radioactive substances of periods 14.5 days and 2.6 hr., but no trace of that of period 26 min. [see Abstract 4243 (1937)]. That of period 2.6 hr. must be due to either $^{31}_{14}\text{Si}$ formed according to $^{34}_{16}\text{S} + \frac{1}{0}n \rightarrow ^{31}_{14}\text{Si} + \frac{4}{2}\text{He}$ (1), or to ^{33} or $^{34}_{15}\text{P}$ formed by ^{33} or $^{34}_{16}\text{S} + \frac{1}{0}n \rightarrow ^{33}$ or $^{34}_{15}\text{P} + \frac{1}{1}\text{H}$ (2). Chemical investigation is in favour of (1). This conclusion is supported by the fact that $^{31}_{14}\text{Si}$ formed from other sources has the period 2.6 hr. [see Abstract 3192 (1938)]. C. A. S.

4059. Artificial Radioactivity as a Test for Minute Traces of Elements. G. T. Seaborg and J. J. Livingood. *Am. Chem. Soc., J.* 60. pp. 1784-1786, Aug., 1938.—It is shown how it is possible to detect and identify very small amounts of impurities by means of their characteristic half-lives, after the substance containing the impurities has been rendered radioactive by bombardment with charged particles of high energy or with neutrons. With the help of a chemical separation after the bombardment, impurities present to the order of 1 part in 10^6 can sometimes be detected. For example, a gallium impurity of six parts per million was found in a sample of iron. Impurities to the extent of 1 part in 10^3 to 10^4 can often be detected without subjecting the sample to chemical analysis. AUTHORS.

4060. Re-Emission of α -Particles Absorbed by Light Nuclei. F. Perrin. *N. Cimento*, 15. pp. 189-192, March, 1938. *In French*.—To explain the experiments of Pawlowski, who found that some α -particles appeared in all directions after incidence on light nuclei, it is suggested that the α -particles are re-emitted after a period of absorption of about 10^{-13} sec. N. Bohr (*ibid.* p. 192) considers that the explanation presents serious difficulties. F. C. C.

4061. Observation of α -Rays on Irradiation of Th and U with Ra + Be-Neutrons. G. F. v. Droste. *Zeits. f. Physik*, 110. 1-2. pp. 84-94, 1938.—Investigations were undertaken on the basis of the observations made by Meitner, Hahn, and Strassmann [see Abstract 3314 (1937)] in order to test whether any observations could be made of the appearance of α -particles during the bombardment of U and Th by neutrons. An arrangement was used consisting of an ionisation chamber in connection with a re-duplicator with which it was possible to register individual α -rays in presence of almost 400 mg. Ra equivalent within 1.5 cm. distance from the measuring chamber with filtration through 1.5 cm. of W. Within a limit of error of ± 0.5 particles per min. there was in the case of U nothing found. This is in agreement with what is observed by chemical means. J. J. S.

4062. Disintegration of Po. M. Ferber. *Comptes Rendus*, 207. pp. 336-337, Aug. 1, 1938.—In a consideration of some records of α -particles from Po [see Abstract 1121 (1938)] a new method is employed which shows that there is a dependence in certain groups of disintegrations.

An expression is obtained for the total probability which suggests that a physical reality is concerned. G. O. B.

***4063. Neon Lamp as γ -Ray Counter.** G. Lovera. *N. Cimento*, 15. pp. 145-148, March, 1938.—The possibilities of various commercial flashing neon lamps as recorders of β - and γ -rays are examined. The count-voltage curve is similar to that for a Geiger counter, showing a short region of constant sensitivity. The behaviour of Osram and Phillips lamps is compared and it is suggested that under certain circumstances such lamps may replace the ionisation chamber as current measuring instruments. F. C. C.

***4064. Intermittent Amplifier for Rapid Counting of Geiger-Müller Impulses.** L. Kowarski and S. Winter. *J. de Physique et le Radium*, 9. pp. 251-258, June, 1938.—A reduction in the number of impulses reaching the recorder can be achieved by using an amplifier which is periodically inactive. Unfortunately the recorded fraction is subject to statistical fluctuations and the method is therefore less exact than the Wynn-Williams scale-of-eight amplifier. The apparatus is, however, simpler and more easily manipulated. It consists of a double counter amplifier of Rossi type and an oscillator of variable frequency. The recorder registers coincidences between a controlled fraction of the natural period and impulses received from the counter. The half-value period of radioactive Ag is found under various conditions to illustrate the flexibility of the apparatus. F. C. C.

***4065. H.F. Multiple Accelerators.** E. O. Schlosser. *Zeits. f. techn. Physik*, 19. 8. pp. 237-240, 1938.—Mathematical examination of the variation of the efficiency of h.f. multiple accelerators under different conditions. F. C. C.

***4066. Transmutations and High Voltages.** M. Pauthenier. *Soc. Franç. Élect., Bull.* 8. pp. 687-706, Aug., 1938.—Review of the methods of producing and measuring high potentials, accompanied by a description of some of the results obtained on the artificial disintegration of the elements under high velocity positive ion bombardment. F. C. C.

***4067. D.C. Production at High Voltage.** R. Planiol. *Comptes Rendus*, 207. pp. 323-324, Aug. 1, 1938.—Attempts are described at constructing a h.v. generator for the efficient acceleration of streams of ions [see Abstract 3703 (1937)]. Electrostatic machines having been rejected, and devices employing electron tubes not being sufficiently reliable or durable, rectifiers are examined for the purpose. A suitable copper-oxide rectifier gives 128 mA at 135 kV from a 150 kVA transformer. A. Hu.

***4068. Improved Ionisation Chamber for α - and H-Rays.** J. Schintlmeister. *Phys. Zeits.* 39. pp. 612-615, Aug. 15, 1938.—A description is given of an ionisation chamber for recording α - and H-rays, which is divided by a central grid into two sections. By means of this electrode, double recording of each ray is possible and thus the range and direction of the rays in the chamber can be ascertained for both α - and H-rays separately. A modified chamber with three electrodes is also described. G. O. B.

See also Abstracts 3965, 4255, 4256.

RADIATION.

ABSORPTION.

4069. Absorption of Light by Crystals. N. F. Mott. *Roy. Soc., Proc.* 167A. pp. 384-391, Sept. 6, 1938.—The mechanism of the absorption of light by solids is discussed from the theoretical point of view. The energy of a quantum of radiation can be converted into heat, re-emitted as fluorescent radiation, or used up in producing a photo-electric current within the solid; estimates are made of the dependence on temperature of the relative probabilities of these processes, which are compared with experiment. AUTHOR.

COLORIMETRY.

4070. Hue-Difference Sensitivity and Schrödinger's Theory. J. Rosemann. *Ann. d. Physik*, 32. 7. pp. 640-664, Aug., 1938.—Describes the results of an experimental investigation of the hue-difference sensitivity of the eye and compares these with the theory propounded by E. Schrödinger [see Abstract 856 (1921)]. Departures were found at the red end of the spectrum in contradistinction to the findings of A. Klughardt and M. Richter whose results showed departures at the blue end. J. W. T. W.

4071. Correlation of Colour Temperatures Based on the Wien and Planck Formulæ. R. S. Estey. *J.O.S.A.* 28. pp. 293-295, Aug., 1938.—Gives a conversion table by means of which reciprocal temperatures on the Wien scale can be readily converted to the Planck basis for use in colorimetric computations. The relation is also shown in two diagrams, one giving the difference, plotted against Wien colour temperature, the other showing both scales plotted on the colour triangle. J. W. T. W.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

4072. Absolute Measurement of Kerr Constants with Alternating Potential. Y. Björnståhl. *Phys. Zeits.* 39. pp. 585-587, Aug. 1, 1938.—The relationship between the double refraction produced in a liquid by an alternating electric field and the Kerr constant is examined and discussed. It is shown that it is possible to carry out an absolute measurement of the Kerr constant with alternating potential; for this the validity of Talbot's law has to be assumed. J. E. K.

4073. Paramagnetic Rotatory Power of Hydrated Ethyl Sulphate of Nd in the Direction of the Optic Axis. J. Becquerel, W. J. de Haas and J. van den Handel. *K. Onnes Lab., Leiden, Comm. No. 244b. Physica*, 5. pp. 753-762, Aug., 1938. *In French*.—It is found that the hydrated ethyl sulphate of Nd obeys the same law as the corresponding compounds of Dy, Er and Pr [see Abstract 610 (1937)]. At liquid H₂ temperatures there is a second energy level. The thermomagnetic properties of the above ethyl sulphate are compared with those of the octohydrated sulphate. G. E. A.

4074. Magneto-Optical Activity of Crystalline NiSO₄ · 6H₂O. F. G. Slack, R. T. Lageman and N. Underwood. *Phys. Rev.* 54. pp. 358-360, Sept. 1, 1938.—The dispersion of the Verdet constant of crystalline nickel sulphate α -hexahydrate has been measured through the visible spectrum. Temperature effect has also been investigated over

a narrow range of temperatures. All measurements are made with the light path parallel to the optic axis of the crystal. The magnetic rotatory dispersion curve may be fitted by a single term electronic dispersion equation as suggested by Drude. Calculation on this basis indicates an active absorption band at 964 Å. The Verdet constant is found to be inversely proportional to the absolute temperature, throughout the range measured. The Verdet constant for the sodium D line is 0.0221 min./oersted-cm. [See also Abstract 4107 (1938).] AUTHORS.

4075. Effect of Magnetic Field upon Mercury Discharge Radiation. V. Fabrikant and G. Rokhlin. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 5. pp. 393-396, 1938. *In English.*—Application of a non-homogeneous magnetic field of moderate intensity to a low pressure Hg discharge results in a considerable increase in the intensity of the emitted radiation. The behaviour is attributed to longer electron paths which result in more molecular excitation. The effect on different spectral lines was examined in detail. As the increase in illumination rises more rapidly than the increase in power supplied to the lamp, the results may lead to a new method of increasing the light output of lamps. F. C. C.

EMISSION.

4076. Emission of Light-Quanta of Long Wave-Length. W. Pauli and M. Fierz. *N. Cimento*, 15. pp. 167-188, March, 1938. *In German.*—The problem of the deflection of a charged particle passing through a field of force is discussed by assuming a finite size for the particle. Although some of the difficulties of infinite energy are overcome, it is admitted that the calculations can hardly apply to actual electrons. G. C. McV.

***4077. Source of Mercury Resonance Radiation of High Intensity for Photochemical Purposes.** E. W. R. Steacie and N. W. F. Phillips. *Canad. J. of Research*, 16. Sect. B. pp. 219-221, July, 1938.—A lamp-reaction vessel system for photochemical purposes is described. This is very inexpensive and has an unusually high intensity of Hg resonance radiation (about 1.5×10^{-5} einstein per sec.). AUTHORS.

4078. Cosmic Rays and Nuclear Forces. I. Tamm. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 6-7. pp. 475-478, 1938. *In English.*—The possible transmutation of the mass of heavy electrons is examined theoretically and it is considered that such transmutation cannot occur in the absence of strong nuclear fields. Reasons are given for believing that the change heavy electron $\rightarrow$ ordinary electron is reversible. F. C. C.

4079. Heavy Electrons in Cosmic Rays. V. Veksler and N. Dobrotin. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 6-7. pp. 479-482, 1938. *In English.*—Using two groups of five proportional counters located one inside the other, a marked decrease was observed in the number of coincidences when an iron plate was placed between them. The behaviour is attributed to heavy electrons produced by the interaction of cosmic rays with matter. F. C. C.

4080. Earth's Magnetic Field and Cosmic Radiation. V. F. Hess, A. Demmelmair and R. Steinmaurer. *Akad. Wiss. Wien, Ber.* 147. 2a. 3-4. pp. 89-100, 1938.—Cosmic-ray ionisation records taken on the Hafelekar in 1936-7 show the following correlations between cosmic-ray intensity and the strength of the earth's horizontal magnetic component: (a) the daily mean cosmic-ray intensity varies in the same

direction as does the field during magnetic disturbances, but often at other times as well; (b) more generally the variations of the daily mean cosmic-ray intensity are in the opposite direction to variations of the field when long periods are considered; (c) the mean variation in the course of the day is in the opposite direction to the field strength variation; (d) the seasonal variation is in the opposite direction to that of the field. The first three effects are explained in terms of Chapman's hypothesis of extra-terrestrial currents encircling the earth. D. H. F.

4081. Absorption of Penetrating Component of Cosmic Radiation. W. M. Nielsen and K. Z. Morgan. *Phys. Rev.* 54. pp. 245-248, Aug. 15, 1938.—Measurements of the absorption of cosmic radiation by Pb in thicknesses up to 550 gm./cm². were made by means of counters in a rock cavern at a depth of approximately 60 m. water equivalent. Comparison with measurements taken outside the cavern showed a hardening of the penetrating component after passing through the rock. The percentage of soft radiation inside and outside the cavern is about the same in the two cases (25-30%). It is considered that it is unnecessary to assume the transmission of cosmic-ray energy to these large depths by non-ionising particles, such as neutrinos. The character of the absorption curve for the soft component under a depth of 60 m. water equivalent shows that it must be possible for the penetrating component to generate secondaries of considerable energy. D. H. F.

4082. Residual Currents and Deep Water Measurements of Cosmic Rays. S. Szczeniowski and S. Ziemecki. *Acta Physica Polonica*, 7. 1. pp. 59-67, 1938. *In English*.—Residual currents in two ionisation chambers, one filled with A, the other with air, at pressures up to 30 atm., have been measured in a rock-salt mine at a depth of 406 m. The residual current diminished with diminishing pressure. Very marked fluctuations, sometimes several times the mean value, were observed. It is considered that this and some of the other observed details can perhaps be explained by the hypothesis of an emission of positive particles, of an unspecified nature, from the walls of the chamber. It is considered that these findings have a bearing on the contradictory and anomalous results found by other investigators under great depths of water. D. H. F.

4083. Large Atmospheric Cosmic-Ray Showers. P. Auger and R. Maze. *Comptes Rendus*, 207. pp. 228-230, July 18, 1938.—Further experiments with widely separated counters have shown that the large showers of penetrating particles previously reported [see Abstract 3212 (1938)] may cover an area of 1000 m². and consist of several tens of thousands of particles, of which about one-half are able to penetrate 5 cm. of Pb. Such showers would require the energy of the particle producing it to be about 10¹² or 10¹³ eV. The significance of these results in relation to certain other cosmic-ray phenomena is briefly pointed out. D. H. F.

4084. Cosmic-Ray Showers under 30 m. of Clay. J. D. Crawshaw. *Phys. Soc. Proc.* 50. pp. 783-787, Sept. 1, 1938.—The vertical intensity of the cosmic radiation and of the cosmic-ray shower-intensity have been measured at ground level and at a station 30 m. below the surface, and the ratio of these two quantities has been shown to be nearly the same at the two levels. A transition curve in lead has been obtained at the Holborn Underground station and its shape differs widely from the typical curve obtained at sea level. After a sharp initial rise, the shower-rate remains stationary for thickness of lead up to 8.8 cm., in contrast to the

rapid decrease which occurs after the maximum at sea level. The curves obtained underground are shown to be very similar to those obtained by Drigo at sea level under about 2 m. of masonry. AUTHOR.

4085. Shower Frequency and Cosmic-Ray Intensity. L. Jánossy. *Roy. Soc., Proc.* 167A. pp. 499-508, Sept. 23, 1938.—The frequency of cosmic-ray showers was observed at sea-level and under 30 m. of clay (60 m. of water equivalent). The shower frequencies at the two levels were compared with the corresponding vertical intensities. Part of the experiments were carried out with layers of light material close above the lead in order to maintain similar geometrical conditions for the shower production at both levels. The marked observed effect of the stone on the transition curve can be understood as due mainly to the spatial association of the shower-producing electrons emerging from the stone, rather than to filtration. The relative shower intensity, *i.e.*, (shower frequency/vertical intensity), of the showers producing the first slope of the transition curve was found to be nearly the same at sea-level and underground; on the other hand, the shower frequency due to showers producing the tail of the transition curve increases relatively with depth. The conclusion was drawn that most of the showers at sea-level and underground are due to secondaries of some kind produced by the penetrating particles, and that consequently relatively few can be due to primary electrons.

AUTHOR.

4086. Transition Effects of Cosmic Rays in the Atmosphere. R. Serber. *Phys. Rev.* 54. pp. 317-320, Sept. 1, 1938.—The calculation of the multiplication of the soft component of the cosmic rays in the upper atmosphere is refined by use of the exact high energy radiative formulæ of Bethe and Heitler, and the resulting diffusion equations are solved by the method of Snyder. Comparison with the vertical counter work of Pfozter, and of Carmichael and Dymond, and with the ionisation chamber data of Bowen, Millikan, and Neher, shows that the calculated position of the maximum of the multiplication curve is now in good agreement with that observed. The latter comparison also indicates that the penetrating component is at least largely of secondary origin. AUTHOR.

See also Abstracts 3995, 4093.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

4087. Powerful Fluorescence of Calcareous Minerals. M. Dérivé. *Comptes Rendus*, 207. pp. 222-223, July 18, 1938.—Many calcareous minerals have been found to show a powerful luminescence in Wood-filtered u.v. light which persists in some cases for several seconds. Temperature appears to have no effect in many cases, but the hydrated minerals lose their phosphorescent power when water of inclusion is driven off. The time decay curves are exponential. J. E.

4088. Colour and Fluorescence of Dyestuffs. B. Bugyi. *Kolloid Zeits.* 84. pp. 74-84, July, 1938.—The colour and fluorescence of some 40 dyestuffs under different conditions—(solid, neutral solution, acid and alkaline solution, alcoholic and aqueous solutions and in capillary adsorption) and under excitation by daylight and filtered Hg light, have been examined. The colour and fluorescence show in general marked differences in the various states. Some possible interpretations of the differences are mentioned. Three tables are given showing the colours and fluorescence of the dyestuffs investigated. J. E.

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***4089. Fluorescence and Photodecomposition of Acetone Vapour.** M. S. Matheson and W. A. Noyes, Jr. *Am. Chem. Soc., J.* 60. *pp.* 1857–1864, *Aug.*, 1938.—An apparatus for studying the fluorescence of gases is described. The ratio of absorbed to fluorescent intensity of acetone is a function both of incident intensity and of time of exposure. Only at very low intensities is a Stern-Volmer equation obeyed. The fluorescence spectra of acetone and of biacetyl are identical at wave-lengths longer than 5000 Å. The fluorescence in the blue, which alone appears when O₂ is present, is much weaker than the fluorescence at longer wave-lengths and could not be photographed. Small amounts of biacetyl greatly increase the fluorescence of acetone. It is concluded that the fluorescent emitters are the same for both acetone and biacetyl, at least as regards the bands at 5000 Å and longer wave-lengths. Mechanisms to account for these facts are advanced. An adequate explanation is based on a very probable deactivation of excited acetone molecules by biacetyl, the excited biacetyl being responsible for the fluorescence. However, fluorescence of the CH₃CO radical cannot be excluded. AUTHORS.

4090. Fluorescent Ion of Chromium in Ruby. B. V. Thosar. *Phil. Mag.* 26. *pp.* 380–389, *Sept.*, 1938.—The Zeeman pattern of the red fluorescence doublet of ruby at –180° C. has been explained on the supposition that the fluorescent Cr⁺⁺⁺ ions enter the crystal lattice of Al₂O₃, substituting in places the Al-ions, and that it is the spin-moment only and not the orbital moment that responds to the magnetic field. This is shown to be in entire agreement with the theory of paramagnetism of the ions of the transition series, as developed by Bose, Stoner, and others. Taking the Landé factor $g = 2$, the calculated Zeeman interval is shown to be of the same order of magnitude as the observed one, but numerically different. A possible explanation of this disagreement and of the asymmetry of the pattern has been indicated. Reasons for the difference in intensity of the red doublet for ruby and sapphire and in their colour have been offered. The curiously great intensity of this forbidden doublet has also been explained. AUTHOR.

4091. Fluorescence in a Layer of Thickness Comparable to Wave-Lengths. Part II. F. S. Baryšanskaja. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 6–7. *pp.* 465–468, 1938. *In French.*—A continuation of previous work [see Abstract 647 (1938)]. Results are given for solutions of fluorescein in water and in glycerin illuminated obliquely and observed from above and obliquely. J. E.

4092. Polarisation of Band Fluorescence of Metal Vapours. S. Mrozowski. *Acta Physica Polonica*, 7. 1. *pp.* 45–48, 1938. *In German.*—The degree of polarisation of Te and of Se vapours excited by Hg 4358 Å has been determined. Agreement is found with the calculations based on Placzek's formula. J. E.

***4093. Luminescent Materials and Application to Light Sources.** J. W. Ryde. *Illum. Eng. Soc. (London), Trans.* 3. *pp.* 114–125; *Disc.*, 125–128, *Aug.*, 1938.—After an historical survey of the subject the author briefly describes the various forms of luminescence, *viz.*, chemi-luminescence, bio-luminescence, flame luminescence of solids and photo-luminescence. In the final category he deals with organic substances, pure inorganic compounds and, finally, activated inorganic substances. The effects of various metals as activators are described and the modifications of colour which can be produced by a change of proportions in a suitable mixture are mentioned. In the final section of the paper, the

conditions to be satisfied by a substance to be used in conjunction with a discharge lamp are listed and the developments now proceeding in the production of practical lamps depending on luminescence are briefly referred to. Finally, a table of luminous efficiencies of various types (in lumens/W) is given. The values range from 15 (pale blue or pink) to 60 (bright green). In the *Discussion*, **J. T. Anderson** referred to the activation of inorganic substances by organic compounds. The author stated that in the case of inorganic compounds deterioration was due to a chemical change and could be prevented by incorporating the material in a suitable medium. This did not apply in the case of the fluorescent organic dyes.

J. W. T. W.

***4094. Fluorometer.** **O. Maercks.** *Zeits. f. Physik*, 109, 11–12, pp. 685–699, 1938.—Two fluorometer arrangements are described in which stationary supersonic waves are used to interrupt the light. The exciting light passes through a trough in which it is modulated by supersonic stationary waves and is then concentrated on to the cell containing the fluorescent liquid. The fluorescent light scattered at right angles to the direction of the exciting light is led back by a lens and prism through the first trough in a direction crossing the exciting beam at right angles, falling finally on a differential photo-cell. If the decay time were infinitesimal the effect on the photo-cell would be a maximum when the amplitude of the supersonic wave is a minimum but with a finite decay time the fluorescent light is retarded by the mean decay time and reaches the first cell again when the supersonic wave has an amplitude which is no longer zero. The fluorescent light passing through the first cell is thus diffracted and the photo-cell gives a smaller reading. To find the decay time the cell containing the fluorescent liquid is replaced by a half-silvered plate. The exciting light is then passed through this and on to a prism which reflects it back again. The distance of the reflecting prism is varied till the reading of the photo-cell is the same as with the liquid in place. Then the time taken for the light to pass from half-silvered plate to reflecting prism and back is equal to the mean decay time. In a second arrangement the time of decay is determined by comparing the appearance of a stroboscopic disc when illuminated first by the modulated exciting light and then by the modulated and delayed fluorescent light. The limits of error of the methods are considered to be of the order $\pm 0.2 \times 10^{-9}$.

J. E.

See also Abstract 4147.

INTERFERENCE, DIFFRACTION AND SCATTERING.

4095. Distribution of Intensity in Interference Fringes. **J. Roig.** *J. de Physique et le Radium*, 9, pp. 241–244, June, 1938.—A method is described for separating the width of the fringe due to the line width from that due to the apparatus in the case in which the former is large (line widened by the Doppler effect) and the effect of the latter is small (a large path difference).

H. G. C.

See also Abstracts 3937, 3964, 4116, 4182, 4183, 4202.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

4096. Photochemical Decomposition of N_2O . **F. C. Henriques, Jr., A. B. F. Duncan and W. A. Noyes, Jr.** *J. Chem. Phys.* 6, pp. 518–522, Sept., 1938.—O atoms were produced in $NO_2 - N_2O$ mixtures

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by the photo-decomposition of NO_2 alone. No reaction of these atoms with N_2O could be detected. Results of calculations give a minimum activation energy of 14,000 cal. for the reaction $\text{O} + \text{N}_2\text{O} = 2 \text{NO}$ and a probable maximum activation energy of 24,000 cal. The activation energy of the reaction $\text{O} + \text{NO}_2 = \text{NO} + \text{O}_2$ is estimated to be 4000 cal. It is concluded that two primary processes are necessary to explain the direct photo-decomposition of N_2O , $\text{N}_2\text{O} + h\nu = \text{N}_2 + \text{O}$ and $\text{N}_2\text{O} + h\nu = \text{NO} + \text{N}$. The latter reaction must be followed by $\text{N} + \text{N}_2\text{O} = \text{NO} + \text{N}_2$ to explain previously determined quantum yields. The energy of activation of this reaction is probably less than 10,000 cal. [See Abstract 4938 (1937).] AUTHORS.

4097. Photochemical Primary Process of Ions in Aqueous Solution. A. Farkas and L. Farkas. *Faraday Soc., Trans.* 34. pp. 1113–1120, Sept., 1938.—It is shown, on the basis of energetic considerations, that the present interpretation of the electron affinity spectra has to be modified. It is suggested that the process occurring in the absorption of light is the transfer of an electron from the ion to the water molecule in the hydration layer. From this intermediate state the electron can either return to its initial state when no photochemical change is to be observed, or can pass over to the final state resulting in a chemical reaction. In the reaction of negative ions, the final state is reached by the transfer of the electron to a positive ion. For the iodine ion this mechanism is formulated as $(\text{I}^- \cdot \text{H}_2\text{O}) + h\nu \rightleftharpoons \text{I} \cdot \text{H}_2\text{O}^-$; $\text{I} \cdot \text{H}_2\text{O}^- + (\text{H}^+) \rightarrow \text{I} + \text{H}_2\text{O} + \text{H}$. The energy of the absorbed radiation is given by $h\nu = E + H - E_{\text{H}_2\text{O}}$, where E is the electron affinity of the I atom, H the energy of hydration of the iodine ion and $E_{\text{H}_2\text{O}}$ the electron affinity of water (about 18 cal.). It is shown that this mechanism accounts for the relative position of the absorption spectra of the halogen ions and for the dependence of the photochemical quantum efficiency on concentration and acidity. For the SO_3^- ion essentially the same equations are valid but the energy level of the intermediate state is lowered by the residual polarisation of the water molecules around the SO_3^- ion. For the ferrous ion the primary process is also the transfer of an electron to a water molecule in the hydration layer; the photochemical change occurs when the $(\text{Fe}^{++} \cdot \text{H}_2\text{O}^-)$ complex of the intermediate state decomposes into $(\text{Fe}^{++} - \text{OH}) + \text{H}$. AUTHORS.

4098. Separation of Hydrogen Isotopes in Photochemical Liberation from Aqueous Solutions. A. Farkas and L. Farkas. *Faraday Soc., Trans.* 34. pp. 1120–1127, Sept., 1938.—The separation of the H isotopes occurring in the photochemical liberation of H from aqueous solutions of iodide, sulphite and ferrous ions has been investigated. In solutions containing 15–78% of D the following separation factors were observed: for acidulated iodide, 3.7–6.5; for sulphite, 10.6; for ferrous ion, 3.8–4.8. The possible causes of the separation are discussed and it is suggested that the separation occurs in the photochemical process, a H atom having about four times greater probability of being formed than a D atom. The dependence of the separation factor on the concentration of D in the case of the iodide ion is attributed to the relative distribution of H and D atoms in the hydroxonium ions. The high separation factor for the sulphite ion is apparently partly caused by the isotopic effect in the heat of hydration of the sodium ion and partly by secondary reactions. AUTHORS.

4099. Chemical Reactivity. H. W. Melville. *Roy. Inst., Proc.* 30. 2. pp. 358-377, 1938.—The author discusses present ideas concerning the nature and mechanism of chemical reactions, limited, however, to gas reactions. Variation in rate of reaction is first considered and the reason for chemical inertia explained. This involves consideration of the 4 classes of activated molecules: (a) Those in which one or more of the electrons have been excited to a higher energy level; those possessing (b) translational, (c) vibrational, and (d) rotational energy in excess of the mean value. In the two latter classes the energy may be so large that the molecules are dissociated to free atoms or radicals. The explanations are accompanied by very complete descriptions of experimental illustrations. Work with atomic H receives special attention and associated therewith is the production of CH and C₂ molecules. A device is also shown for the measurement of the lifetime of fluorescence decay. The photochemical method of producing activated molecules and so inducing reaction to occur is shown to have the great merit that the conditions in the system may be changed independently of the source of excitation. This measure of control is much used in unravelling complex reactions when a whole series of consecutive processes have to be separated into their components, e.g., polymerisation of simple molecules to synthetic resins, rubbers, etc. An Appendix deals with the construction of a potential energy model.

H. H. Ho.

4100. Rapid Development and Fixing of Photographic Negatives. A. Charriou and S. Valette. *Soc. Franç. Phot. et Ciné, Bull.* 25. pp. 125-131, Aug., 1938.—Briefly examines the results obtained from 16 developing and 11 fixing solutions, considering the choice of the best solutions, and the practical applications. Solutions, and methods of treatment, are given which will give a negative in approximately 90 sec. at 20° C. with normal emulsions, or in 35 sec. at 50° C. with certain special emulsions.

R. C. F.

4101. Theory of Additive Three-Colour Photography. A. C. Hardy. *Phot. J.* 78. p. 546, Aug., 1938.—A brief note continuing the discussion on the paper by Harrison and Horner [see Abstract 3226 (1938)].

R. C. F.

See also Abstracts 4077, 4089.

PHOTOMETRY.

4102. Tungsten, Mercury and Sodium Illuminants at Low Brightness Levels. M. Luckiesh and A. H. Taylor. *J.O.S.A.* 28. pp. 237-240, July, 1938.—Photometric brightness matches between W filament light and Na or Hg light were made at different brightness levels and with different sizes of the photometric field. The results were in general agreement with expectations from the Purkinje effect. Other measurements of the smallest perceptible contrast for the three illuminants appeared to show that the greater loss of brightness with Na light at low brightness levels is fully compensated for by an increased sensitivity to threshold stimulus (energy density) difference.

W. S. S.

***4103. Microphotometer.** E. E. Berkley and O. C. Woodyard. *Indust. and Engin. Chem. (Analytical Edition)*, 10. pp. 451-455, Aug. 15, 1938.—Describes the construction, method of use, and results obtained with a new microphotometer developed for the measurement of X-ray diffraction patterns, and used with diffraction patterns of raw cotton fibres. The photometer consists of a constant light source focused on the

pattern, a measuring device composed of a photo-cell and a galvanometer system, and a compound mechanical stage for holding and moving the patterns under the light beam while measuring them. The instrument is stable, and shows a high degree of precision in repeated measurements, particularly if the patterns are for samples under tension when their Chandler strengths can also be obtained.

R. C. F.

POLARISATION.

4104. Temperature Dependence of the Degree of Depolarisation of Gaseous CO_2 , N_2O and C_2H_2 . R. Schmidt. *Phys. Zeits.* 39. pp. 574-580, Aug. 1, 1938.—The dependence of the degree of depolarisation of gaseous CO_2 , N_2O and C_2H_2 on temperature is measured by the usual cross-tube method. Convergent light is used and the results are obtained by photometric evaluation of photographic records; the temperatures at which records are taken are 20, 40, 60 and 85° C. For temperature changes of about 30% of the absolute temperature there is no change in the degree of depolarisation within the limits of experimental error of $\pm 5\%$.

J. E. K.

4105. Rotatory Power of Quartz in the Far Ultra-Violet and in the Schumann Region. R. Servant. *Comptes Rendus*, 207. pp. 283-285, July 25, 1938.—The study of the rotatory power, ρ , of quartz is extended beyond 1854 Å into the Schumann region, where an enormous increase in ρ is found. Concordant results are obtained which allow the construction of the dispersion curve. Comparison of experimental results with those obtained from the two existing formulæ indicate that the formulæ appear to be inadequate.

W. R. A.

4106. Rotatory Dispersion in the Amine Series. Part IV. W. C. G. Baldwin. *Roy. Soc., Proc.* 167A. pp. 539-554, Sept. 23, 1938.—Variations in Drude equations for the rotatory dispersions, and changes in specific rotation, which occur on neutralisation, are utilised for the detection of induced dissymmetry in the amino-radical of optically active bases. When the lone pair of electrons of the N atoms becomes bound in any way, the partial rotation associated with it disappears. An attempt is made to explain the behaviour of a few exceptional bases whose rotatory powers contain no contribution which can be attributed directly to the lone pair of electrons. Such bases do not give the large alteration in specific rotation which is usually produced by ionisation. The rotatory dispersion of crystalline ethylene-diamine sulphate is compared with that of *l*-propylene-diamine, *l*-diamino-cyclohexane, and of their salts in solution. Measurements and analyses are given for these two optically active bases, as well as for their mono- and di-hydrochlorides. The results are interpreted in terms of Boys' molecular model, and the absolute configuration of *l*-propylenediamine is defined. In spite of statements in the literature to the contrary, the sign of the specific rotation of this base is actually reversed on ionisation, and this experimental fact constitutes strong evidence in favour of the proposed model. It is shown that the major contribution to the optical activity of *l*-propylenediamine may be attributed to the absorption bands associated with the two lone pairs of electrons in the molecule. Assuming the presence of an unchanging dextro-rotatory nucleus common to all three ionic forms, an attempt to estimate the other contributions to the rotatory power and dispersion is made. The absorption bands between 2300 and 2000 Å which are without exception common to all amines previously investigated are in

the cases of *l*-propylenediamine and *l*-cyclohexane not optically active. The induced dissymmetry is centred at wave-lengths between 1900 and 1400 Å, and is associated with two groups of absorption bands in this region, one due to the lone pairs of electrons, and the other to the more saturated CN and NH linkages. [For Parts I-III see Abstract 4495 (1937).]

AUTHOR.

4107. Optical Activity of Crystalline $\text{NiSO}_4 \cdot \alpha\text{-6H}_2\text{O}$. N. Underwood, F. G. Slack and E. B. Nelson. *Phys. Rev.* 54. pp. 355-357, Sept. 1, 1938.—The optical activity of crystalline nickel sulphate α -hexahydrate has been measured throughout the visible portion of the spectrum. The observations are extended near to absorption regions by an adaptation of the method of Fizeau and Foucault. Both right- and left-hand crystals are found and the rotatory dispersion curves show anomalous rotatory dispersion. By application of Drude's equation, in which two terms are used, the observed anomaly is predicted as due to absorption bands lying at 3954 Å and 7187 Å, respectively. Transmission data for the crystal show the presence of these two bands, in agreement with previous absorption data for solutions of the material. [See also Abstract 4074 (1938).]

AUTHORS.

See also Abstract 4092.

REFLECTION, REFRACTION AND DISPERSION.

4108. Reflection Factor of Clothing. P. Moon and M. S. Cettel. *J.O.S.A.* 28. pp. 277-279, Aug., 1938.—Gives the results of a survey of the reflection factors of a large number of samples of men's clothing. Over 200 samples were measured spectrophotometrically and the reflection factors were calculated for illumination by tungsten filament, mercury and sodium lamps. The tones were, on the average, very neutral so that no considerable difference was found for the three illuminants. Excluding white materials, the range of reflection factors for overcoats and suits was found to be 1.6 to 16%.

J. W. T. W.

4109. Experimental Determination of the Optical Constants of Metals. J. B. Nathanson. *J.O.S.A.* 28. pp. 300-310, Aug., 1938.—An outline is given of the general experimental methods used, and the results that have been obtained, in the study of the optical properties of bulk metals.

A. H.

***4110. Determination of Optical Constants by the Optical Pyrometer.** A. G. Worthing. *J.O.S.A.* 28. pp. 311-312, Aug., 1938.—No new results are presented in this paper which is confined to a discussion of the special features relating to the method.

A. H.

4111. Optical Properties of Alkali Metals. R. W. Wood and C. Lukens. *Phys. Rev.* 54. pp. 332-337, Sept. 1, 1938.—The physical processes responsible for the unique optical properties of Ag, in contrast to those of the alkali metals are briefly discussed from the standpoint of the zone theory of electron distribution in crystals. The results of experiments undertaken in the hope of finding a renewal of reflecting power in the remote u.v. in the case of the alkali metals, are recorded. Photographs of the spectra of the discharge of a condenser through a capillary tube after reflection from metal films condensed at liquid-air temperature showed no return of reflection in the region extending down to 500 Å. AUTHORS.

4112. Refractive Indices of Liquid He I and He II. H. E. Johns and J. O. Wilhelm. *Canad. J. of Research*, 16. Sect. A. pp. 131-132, July, 1938.—The refractive indices of liquid He I and He II were measured by

means of a Wollaston cell. The value obtained with $5461 \text{ \AA}$ for He I at 4.2° K. was 1.0206 ± 0.0012 ; for He I at 2.26° K. , 1.0269 ± 0.0004 ; and for He II at 2.18° K. , 1.0269 ± 0.0004 . It was also shown that the index changed by less than ± 0.00007 in passing from a point in He I to a point with the same density in He II. It is concluded, therefore, that there is no change in the molecular refractivity in passing from He I to He II.

AUTHORS.

4113. Ray-Surface and Optical Indicatrix. G. Tunell. *Washington Acad. Sci.*, J. 28. p. 345, Aug. 15, 1938.—A correction [see Abstract 4082 (1933)].

See also Abstracts 3941, 3953, 4131.

SPECTROSCOPY.

4114. Quantitative Analysis Based on Spectral Energy. M. Slavin. *Indust. and Engin. Chem. (Analytical Edition)*, 10. pp. 407–411, Aug. 15, 1938.—An explanation is given for certain limitations of the commonly used internal standard method, and energy of spectral emission is suggested for measurement of concentration in place of intensity. Experimental work shows that the energy of spectral emission in a carbon arc is directly proportional to the weight of element causing the emission. For quantitative analysis, therefore, it is only necessary to determine energy per unit weight of element on known samples, and apply this value in the analysis of unknowns. This procedure permits working over the entire range from the lowest limit of sensitivity up to 100%. The presence of other elements appears to have no effect on the analysis. The average error was found to be 8.3% and the maximum error was 18.5%.

AUTHORS.

4115. Probable Existence of Element 93 in Natural State. H. Hulubei and Y. Cauchois. *Comptes Rendus*, 207. pp. 333–335, Aug. 1, 1938.—Minerals containing U or Re were treated chemically by a method calculated to concentrate any Element 93 that might be present and then examined spectrographically for the lines indicated by Moseley's theory as those of that element. In this way evidence in support of the probable presence of four of these lines was obtained, and therefore of the probable presence of 93 in quantity sufficient for spectrographic detection, and perhaps even for chemical concentration.

C. A. S.

4116. Interferometric Wave-Length Comparison of the Red Cadmium Radiation Emitted by Different Sources. W. E. Williams and D. V. Gogate. *Roy. Soc., Proc.* 167A. pp. 509–516, Sept. 23, 1938.—A comparison is made between the wave-lengths of the red Cd line $6438 \text{ \AA}$ emitted by a G.E.C. Osira Cd lamp and a Schüler hollow-kathode discharge by photographing the Fabry-Pérot fringes due to the two sources side by side in the same horizontal plane by means of a specially designed plate-holder. Interferometer gaps up to 10 cm. were used, and the greatest difference recorded was less than 1 part in 100×10^6 or $0.00006 \text{ \AA}$.

AUTHORS.

4117. New Terms in Spectrum of Na III. D. H. Tombouljan. *Phys. Rev.* 54. pp. 347–350, Sept. 1, 1938.—The spectrum of Na III has been excited by an electrodeless discharge. Wave-length measurements have been made in the region from 500 to $2600 \text{ \AA}$. On the basis of these determinations it has been possible to establish 30 new levels arising from the $2s^2 2p^4 3p$, $2s^2 2p^4 3d$, and $2s^2 2p^4 4s$ configurations.

AUTHOR.

4118. Spectra of Rb III and Sr IV. D. H. Tombouliau. *Phys. Rev.* 54. pp. 350–354, Sept. 1, 1938.—By applying Shortley's equations to the $4s^2 4p^5 ({}^2P^0)$ $5p$ levels of Rb II, the separation of the ground levels $4s^2 4p^5 {}^2P^0$ of Rb III has been computed, and experimentally observed to be 7380 cm^{-1} . In the case of Sr IV, the ${}^2P^0$ separation has been predicted from the regular doublet law and identified from the data as 9731 cm^{-1} . On the basis of transitions into the ground doublet certain $4s^2 4p^4 4d$ and $4s^2 4p^4 5s$ levels have been located. AUTHOR.

4119. Broadening and Displacement of Higher Series Lines of Sodium by Cs-Vapour. C. Füchtbauer and G. Heimann. *Zeits. f. Physik*, 110. 1–2. pp. 8–20, 1938.—Measurements are made of the broadening and displacement of Na lines due to admixture of Cs in the discharge; the measurements of broadening are made on the lines $1s-9p$ to $1s-12p$ of the principal series and the displacement measurements on lines $1s-9p$ to $1s-20p$. Extremely large broadenings are recorded equal to those of Cs lines produced by Cs; the displacements follow the same trend in the series as those produced by A. The effective cross-section of Cs atoms for slow electrons calculated from the displacement is $25.9 \times 10^3\text{ cm}^2/\text{cm}^3$; this compares with $1.1 \times 10^3\text{ cm}^2/\text{cm}^3$ measured by an electrical method by Brode for electrons of $0.8\sqrt{\text{volt}}$ velocity. J. E. K.

4120. Hyperfine Structure of B, Y, Rh and Pd. D. T. Williams and L. P. Granath. *Phys. Rev.* 54. pp. 338–341, Sept. 1, 1938.—The spectra of B, Y, Rh and Pd excited in an uncooled Schüler lamp, were investigated in the region $\lambda\lambda$ 2500–4000 with a 20-cm. quartz Lummer-Gehrcke plate, in an attempt to find hyperfine structure. None was discovered that could be interpreted either as isotope shift, or as structure due to a nuclear magnetic moment. AUTHORS.

4121. Nuclear Magnetic Moment of Copper. S. Tolansky and G. O. Forester. *Phys. Soc., Proc.* 50. pp. 826–833, Sept. 1, 1938.—The doublet hyperfine structures of the resonance lines of the Cu arc spectrum, λ 3247 and λ 3274, have been measured with a quartz Lummer plate. The lines are produced free from reversal effects, the doublet separations being respectively 379 and $405 \times 10^{-3}\text{ cm}^{-1}$. The following hyperfine structure interval factors are calculated. $3d^{10} 4s^2 S_{\frac{1}{2}} = 197.5$, $3d^{10} 4p^2 P_{\frac{1}{2}} = 14$ and $3d^{10} 4p^2 P_{\frac{3}{2}} = 4.8$ (all in $\text{cm}^{-1} \times 10^{-3}$). The mean nuclear magnetic moment for the two Cu isotopes, 63 and 65, is derived from the ground state, $3d^{10} 4s^2 S_{\frac{1}{2}}$. The value found is $\mu = 2.47$ nuclear magnetons, this being probably a better estimate than that given by other terms, since the ground state is spherically symmetrical and thus not affected by quadrupole moment of the nucleus. By adopting Schüler and Schmidt's value for the ratio of the magnetic moments of the two isotopes, it is found that μ (${}^{63}\text{Cu}$) = 2.43 and μ (${}^{65}\text{Cu}$) = 2.54 nuclear magnetons. AUTHOR.

4122. Atomic Energies for Configurations Containing Almost Closed Shells. T. Yamanouchi. *Phys. Math. Soc. Japan, Proc.* 20. pp. 478–483, June, 1938.—A vector-model method is given for calculating the energy expression for an atom or ion comprising a core with an almost complete shell in a definite multiplet state to which one inequivalent electron is added. Some simple interval rules for the terms of highest multiplicity arising from configurations containing p and d electrons are derived and are tested by comparison with experimental values. The method can be generalised for the cases in which the core contains other electrons besides

the almost closed shell or more than two electrons are added to the core.

J. E. K.

4123. Lower Limit for Theoretical Energy of Normal State of Helium. A. F. Stevenson and M. F. Crawford. *Phys. Rev.* 54. pp. 375-379, Sept. 1, 1938.—The method of using a modification of Weinstein's lower limit for the energy, as given recently by one of the authors [*ibid.* 53. p. 199, Jan. 15, 1938] has been applied to the normal state of He, with the same sequence of functions as was employed by Hylleraas in his upper limit calculations. The ninth approximation leads to the lower limit -1.45508 Hylleraas units, which can very probably be increased to -1.45446 , whereas the upper limit found by Hylleraas is -1.45187 . The bearing of the results found on the probable location of the true eigenvalue is discussed, as is also the applicability of the method in general.

AUTHORS.

4124. Absorption Spectra of Cis- and Trans-Isomers in the Near Infra-Red. Yeou Ta. *Comptes Rendus*, 207. pp. 326-329, Aug. 1, 1938.—An extension of work already noted [see Abstract 3251 (1938)].

W. R. A.

4125. Infra-Red Absorption Spectrum of H_2O_2 . C. R. Bailey and R. R. Gordon. *Faraday Soc., Trans.* 34. pp. 1133-1138, Sept., 1938.—The infra-red spectrum of H_2O_2 has been examined partly in the liquid, and partly in the gaseous state. In spite of considerably experimental difficulties sufficient bands have been identified to enable reasonable assignments to be made with the help of the Raman spectrum. The spectra are in accordance with the C_2 model suggested by Penney and Sutherland.

AUTHORS.

4126. Inner Rotation and Normal Vibrations of Ethane. Part III. K. Schäfer. Part IV. J. Goubeau and J. Karweil. Part V. J. Karweil and K. Schäfer. *Zeits. f. phys. Chem.* 40. Abt. B. 5. pp. 357-390 and 396, 1938.—In Part III an accurate calculation is given of the entropy and molecular specific heat of C_2H_6 by treating the molecule as a symmetrical top with hindered inner rotation. Schäfer shows that there are 9 modifications of C_2H_6 which do not intercombine and calculates the entropy of this mixture of 9 forms. A comparison with Hunsman's results for the molecular specific heat in Part II [see Abstract 2031 (1938)] and Kemp and Pitzer's values for the entropy [see Abstract 1743 (1937)] shows that the energy of the hindered inner rotation is approximately 3000 cal. This energy value leads to a corresponding torsional vibration of 1130 cm^{-1} . In Parts I and II of the publication this vibration had been assigned to the frequency 740 cm^{-1} . In Part IV a new determination is made of the Raman-spectrum of liquid C_2H_6 . In Part V it is shown that it is possible to interpret the infra-red and Raman-bands of C_2H_6 by substituting the frequency 1140 cm^{-1} for the 740 cm^{-1} fundamental. The fundamentals, overtones and combination tones of C_2H_6 are tabulated under the assumption that the molecule belongs to the symmetry class D_{3h} .

L. K.

4127. Vibrational Spectrum and Thermodynamic Properties of Nickel Carbonyl. B. L. Crawford, Jr., and P. C. Cross. *J. Chem. Phys.* 6. pp. 525-530, Sept., 1938.—The infra-red absorption spectrum of nickel carbonyl has been measured in the gas phase from 4 to 23μ , and in the liquid phase from 1 to 8μ . Normal coordinate treatments of both the square and tetrahedral models of the AB_4C_4 molecule have been applied to the infra-red and Raman data; the results give further evidence of

the tetrahedral structure of nickel carbonyl. An analysis of the vibrational spectrum has been made, based on the tetrahedral model, and has been applied to the statistical calculation of the entropy, heat capacity, and free energy function. AUTHORS.

4128. Vibration Spectra and Molecular Structure. Part IV. Infra-Red Absorption Spectra of Double and Single Molecules of Formic Acid. L. G. Bonner and R. Hofstadter. *J. Chem. Phys.* 6. pp. 531-534, Sept., 1938.—In the present study the absorption spectrum of formic acid vapour between 1 and $15.5\ \mu$ has been investigated under a variety of temperature conditions. The spectrum at room-temperature gives essentially the absorption of the double molecules alone, while that at 140°C . gives the absorption of the single molecules. The results are interpreted in terms of the hydrogen bonding existing in the double molecule. In addition an attempt to prepare and investigate pure formic acid-*d* is reported. [For Part III see Abstract 4543 (1937).] AUTHORS.

4129. Vibration Spectra and Molecular Structure. Part V. Infra-Red Studies on Light and Heavy Acetic Acids. R. C. Herman and R. Hofstadter. *J. Chem. Phys.* 6. pp. 534-540, Sept., 1938.—The infra-red absorption spectra of CH_3COOH and CH_3COOD between 1 and $15.5\ \mu$ have been obtained with a rock-salt prism spectrometer. The association of CH_3COOD has been studied and a value of the heat of dissociation obtained. Positions of the hydrogen and deuterium bonded $\text{O}-\text{H}-\text{O}$ and $\text{O}-\text{D}-\text{O}$ frequencies are given. Making certain assumptions, a value for the shorter $\text{O}-\text{H}$ and $\text{O}-\text{D}$ distances in the dimer rings is found to be $1.07\ \text{\AA}$. [For Part IV see preceding Abstract.] AUTHORS.

4130. Vibration Spectra and Molecular Structure. Part VI. Infra-Red Absorption Spectrum of Heavy Formic Acid. R. Hofstadter. *J. Chem. Phys.* 6. pp. 540-543, Sept., 1938.—The infra-red absorption spectra between 1 and $15.5\ \mu$ of the monomer and dimer of HCOOD have been found with a rock-salt prism spectrometer. The position of the vibration characteristic of the "deuterium bond" in HCOOD has been determined and permits an approximate calculation of the shorter OD distance in the dimer ring. As in CH_3COOD the distance is found to be $1.07\ \text{\AA}$. AUTHOR.

4131. Reflection Spectra of Solid Organic Substances. T. Guilmart. *Comptes Rendus*, 207. pp. 289-291, July 25, 1938.—A brief description is given of the experimental arrangements used in measuring the visible and u.v. reflection spectra of solids. A photographic method was used and intensities of the spectral bands were measured as well as their positions. Results are given of measurements in the u.v. on a series of amides $\text{C}_6\text{H}_5(\text{CH}_2)_n\text{CONH}_2$ where $n = 0, 1, 2, 3, 4, 5, 6$, with reference to the variation with n of the spectral characteristics due to the C_6H_5 and CONH_2 groups. D. H. F.

4132. Absorption Spectra of Coordination Compounds. Part III. R. Tsuchida and M. Kobayashi. *Chem. Soc. Japan, Bull.* 13. pp. 471-480, July, 1938. *In English*.—The absorption spectra of several chromic complexes are examined and discussed in detail. All the compounds examined are found to have at least two bands and in some cases there are three or even four. It is found that the spectrochemical series is coincident with that for cobaltic complexes. The stability of the chromic complexes is discussed and some of the methods of preparation are explained. [For Part II see Abstract 3720 (1938).] A. H.

4133. Absorption Spectra of Phthalocyanines and Associated Compounds. J. S. Anderson, E. F. Bradbrook, A. H. Cook and R. P. Linstead. *Chem. Soc., J.* pp. 1151-1156, Aug., 1938.—The absorption spectra in the visible region of phthalocyanine, fifteen of its metallic derivatives, and a number of associated compounds containing the tetraporphin (porphyrazine) ring have been measured. The spectrum of phthalocyanine is composed of a system of at least seven bands, the main absorption occurring between 6000 and 7000 Å. The relationships between the various spectra are discussed, and they are correlated with the spectra of porphyrins and azaporphyrins. AUTHORS.

4134. Absorption Spectrum of Biacetyl between 1500 and 2000 Å. V. R. Ells. *Am. Chem. Soc., J.* 60. pp. 1864-1866, Aug., 1938.—The absorption spectrum of biacetyl vapour has been investigated with a vacuum grating spectrograph between 2000 and 1550 Å. Absorption regions are found which correspond in general to those in acetone and ethyl methyl ketone, although they are displaced to longer wave-lengths as would be expected due to the juxtaposition of two carbonyl groups. A prominent frequency difference of about 1220 cm^{-1} , is found in the upper state, although the presence of another difference almost exactly half as great renders the interpretation ambiguous. Certain bands occur at wave-lengths sufficiently displaced from those in acetone and ethyl methyl ketone to permit them to be used for the identification of biacetyl in the presence of these other substances. AUTHOR.

4135. Spectra of HgH and HgD. Y. Fujioka and Y. Tanaka. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 797. pp. 713-740, July, 1938. *In English.*— $^2\Pi_{\frac{1}{2}} \rightarrow ^2\Sigma$ and $^2\Pi_{\frac{3}{2}} \rightarrow ^2\Sigma$ bands of HgH and HgD are photographed in the 2nd-order of a 6 m. concave grating. From the analysis the constants of the lower $^2\Sigma$ states are calculated. The spin doubling of the $^2\Sigma$ state is found to be remarkably large. The values calculated for B_v show that their variation with v is so large that it is hardly reliable to use the usual expansion formula. However, the calculation of B_v gives $B_{v,H} = 5.5490 \pm 0.0027$, $B_{v,D} = 2.7989 \pm 0.0029$ and $B_{v,D}/B_{v,H} = 0.5044 \pm 0.0006$. Although this value is not in good agreement with $\rho^2 = 0.5029$, because of the above mentioned circumstance no theoretical discussion is possible. The calculation of the vibrational constant $\Delta G_{v+\frac{1}{2}}$ gives a very rapid decrement for increasing v in the case of HgH as compared with that of HgD. Actually, the use of the expansion formula for G_v gives the wrong sign for $y_v w_v$ in the case of HgH. A. H.

4136. Band Spectrum of MgD^+ . H. Juraszyńska and M. Szulc. *Acta Physica Polonica*, 7. 1. pp. 49-58, 1938. *In German.*—The band system $^1\Sigma^* \rightarrow ^1\Sigma$ has been investigated and consists of numerous bands between 3600 and 2600 Å. The rotation and oscillation constants have been determined and compared with the constants of ionised MgH. F. S.

4137. Band Spectra of Nitrogen Forming a Rydberg Series. T. Takamine, T. Suga and Y. Tanaka. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 807. pp. 854-864, Aug., 1938. *In English.*—Using a 1 m. vacuum spectrograph of Siegbahn type, the absorption bands of N_2 forming a Rydberg series were studied. The absorption bands appear strongly when a condensed discharge is passed through a long He tube, with the vacuum spectrograph containing a small amount of N_2 . Compared with the earlier work of Hopfield, these absorption bands are now extended to the 9th member. Of special interest is the appearance

of an emission band also forming a Rydberg series and converging to the same limit ($A' \ ^2\Sigma_u^+$ of molecular N_2) as that of the absorption bands. These emission bands are apparently due to the trace of N_2 in the discharge tube which is present as an impurity. AUTHORS.

4138. U.V. Band Spectra of HgCl, CdCl and ZnCl. S. D. Cornell. *Phys. Rev.* 54. pp. 341-346, Sept. 1, 1938.—The spectra of the chlorides of Hg, Cd, and Zn, excited in a h.f. discharge, are examined at high dispersion in the region 3200-2000 Å. Vibrational analyses of several systems are presented. Included is a discussion of the electronic configurations involved in the systems analysed. AUTHOR.

4139. Band Spectrum of PbF. Part II. G. D. Rochester. *Roy. Soc., Proc.* 167A. pp. 567-580, Sept. 23, 1938.—An account is given of the emission and absorption band spectra of PbF. Six new systems and two continua are found. The vibrational constants of the stable electronic states of PbF are as follows in cm^{-1} :

State	Probable type	ν_e	ω_e	$x_e\omega_e$	Observed in, emission (E), absorption (A)
X_1	$^2\Pi$	0	507.2	2.30	E and A
X_2		8266	531.1	1.50	E
A	$^2\Delta$	22,567	397.8	1.77	E and A
B	$^2\Sigma$	35,643	612.8	3.42	E and A
C	$^2\Delta$	38,046	594.0	2.50	A
D	$^2\Pi$	43,820	600.0	—	A
E	—	45,400	565.0	—	A
F	$^2\Pi$	47,870	630.0	—	A
2440 Å continuum maximum		~ 41,000			A
3050 Å continuum maximum		~ 32,800			E

The width of the ground state, i.e., 8266 cm^{-1} , is the largest yet recorded. Numerous examples of predissociation are found. [For Part I see Abstract 712 (1936).] AUTHOR.

4140. Optical Behaviour of Dissolved Ions and Structure of Electrolytic Solutions. Part VII. G. Kortüm. *Zeits. f. phys. Chem.* 40. Abt.B. 6. pp. 431-438, 1938.—Measurements are described with respect to the extinction of the fluorescence of eosin anions in extremely dilute aqueous solution by inorganic and organic compounds. This work is an extension and a confirmation of the earlier results [see Abstract 5350 (1937)]. The significance of solvation is established from several examples whereas the ionic behaviour is in numerous cases in accord with the Debye-Hückel limiting laws, and therefore to be ascribed to purely electrostatic interaction of the ions, nevertheless within certain dilution ranges there are specific optical properties of the ions which indicate complete independence from these inter-electrostatic forces and dependence only on the forces between the ions and solvent molecules (solvation forces). The region within which the van der Waals' forces operate is also discussed. H. H. Ho.

4141. Deformation of Molecules and Their Vibration Spectra in Condensed Phases. E. Bauer and M. Magat. *Physica*, 5. pp. 718-724, Aug., 1938. *In French*.—It is well-known that the infra-red and Raman spectra of molecules containing the radicals OH and NH show a widening of the bands and a displacement towards lower frequencies in condensed phases as compared with the gaseous state. This can be accounted for in a satisfactory manner by considering the forces acting between molecules, and it is not necessary to introduce *ad hoc* assumptions, such as that of a specific "H-bond." R. P.

4142. Fluorescence and Absorption Spectra of Pr^{+++} and Eu^{+++} . Part II. H. Lange. *Ann. d. Physik*, 32. 4. pp. 361–377, June, 1938.—In order to investigate the splitting of the ground terms of Eu^{+++} by crystal fields the fluorescence spectra at -180°C . given by Eu^{+++} incorporated in various salts have been studied as well as the absorption spectra in the visible region from 20°C . to -180°C . The results are shown in tables and in reproduction of the spectra. A comparison of the spectra obtained with Eu salts alone and also when incorporated in alkaline-earth sulphates indicates a much more complicated effect of crystal field on the atomic lines in the second case. The results will be discussed in detail in a further contribution. [For Part I see Abstract 2470 (1938).] J. E.

4143. Diffuse Fluorescence Spectra of the Ions of the Rare Earths in Solution and in Crystals. P. C. Mukherji. *Zeits. f. Physik*, 109. 9–10. pp. 573–585, 1938.—The fluorescence spectra of the trivalent ions of La, Ce, Pr and Nd in solution, in crystals and partly also in dehydrated crystals have been obtained. In solution, one wide diffuse band is common to all these ions. In addition, Pr and Nd emit also two weaker bands of shorter wave-length, and Nd a further one of greater wave-length. For monochromatic excitation the short-wave bands are only emitted if the frequency of the exciting radiation exceeds the mean frequency of the shorter band. In crystal form, La ions do not fluoresce, whereas the number of bands from Ce depends on the anion and on the frequency of the exciting radiation. La and Ce produce a measurable continuous u.v. absorption. The results are discussed and an interpretation is suggested. R. P.

4144. Raman Spectra of Crystalline Hydrates. E. Canals and P. Peyrot. *Comptes Rendus*, 207. pp. 224–226, July 18, 1938.—The Raman spectra of a number of hydrates have been obtained. They are all different and unlike that of water. Certain substances—gypsum, hyposulphite of sodium, strontium chloride and alum—have a faint band near 3600 cm^{-1} which may correspond to the 3654 cm^{-1} of water vapour, attributed by Cabannes to monohydrate. J. E.

4145. Raman Spectra of Ammonia and the Ammonium Ion. G. Costeanu. *Comptes Rendus*, 207. pp. 285–286, July 25, 1938.—Liquid NH_3 at -40° exhibits five Raman displacements greater than 3000 cm^{-1} , viz., 3210, 3300, 3380, 3460, 3545 cm^{-1} ; the first three are strong and well-established; the last two are weak and have not previously been recorded. These five lines, with slight modification, are also found in the spectra of a strong aqueous solution of NH_3 and in solutions of NH_4NO_3 and NH_4CNS in liquid NH_3 , respectively $\text{NH}_4\text{NO}_3 \cdot 2\text{NH}_3$ (I) and $2\text{NH}_4\text{CNS} \cdot 5\text{NH}_3$ (II). The spectra of (I) and (II) are compared with that of an aqueous solution of NH_4NO_3 and displacements ranging from 1370 to 1690 cm^{-1} and their origin, are discussed. W. R. A.

4146. Use of Raman Effect in Analysing Isomeric Dihalogenated Benzenes. R. Pajeau. *Comptes Rendus*, 207. pp. 344–345, Aug. 1, 1938.—The bromination of benzene and of chlorobenzene to produce *paradihalogenobenzenes*, catalysed by beryllium bromide and by aluminium chloride has been followed by Raman spectral observations. Aluminium chloride favours the production of the three isomers, whilst with beryllium bromide no *meta* derivative was detectable. W. R. A.

4147. Raman Spectrum and Fluorescence of Dioxane. H. W. Hunter. *J. Chem. Phys.* 6. pp. 544–545, Sept., 1938.—The Raman spectrum of dioxane is shown to include eleven lines, some of which have

been reported by previous investigators. Dioxane, when irradiated by the u.v. light from a mercury arc, gives scattered light whose spectrum shows a broad continuous band in the visible region. Intensity of the scattered band diminishes rapidly with increasing temperature of the dioxane. Shortened time exposures bring out two maxima at about 5800 and 4500 Å. A similar phenomenon has been observed in cyclohexane.

AUTHOR.

4148. Raman Spectra and Structure of Associated Molecules of Organic Acids. V. Čelínzev. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 6-7. pp. 489-491, 1938. *In English.*—The various proposed structures for organic acids associated in the form of dimers are discussed, together with the evidence supporting them. The author rejects the "acetal" form and also the structure in which there is a H bond. He puts forward a structure, which involves a quadrivalent O atom. It is claimed that this structure explains why in certain cases oscillations corresponding to hydroxyl bonds and simple carbonyl groups are absent, or at least much reduced, in the Raman spectra of acids. J. I.

4149. Raman Spectra of Organic Silicates. B. V. Thosar and R. N. Bapat. *Zeits. f. Physik*, 109. 7-8. pp. 472-476, 1938.—The Raman spectra of methyl, ethyl, butyl and isoamyl silicate were studied. The four fundamental vibrations of the SiO_4 group at 650, 840, 1082 to 1100, and 1178 to 1300 cm^{-1} were identified and the values compared with those found by Weiler for the methyl ester and its polymers. W. S. S.

4150. Vibrations and Structure of Ions of the Type XO_3 . T. G. Kujumzelis. *Zeits. f. Physik*, 109. 9-10. pp. 586-597, 1938.—Raman spectra of concentrated solutions of carbonates, nitrates, chlorates, bromates and iodates showed unknown lines which completed the analysis of the vibration frequencies. It is concluded that the ions CO_3 and NO_3 are plane, whereas ClO_3 , BrO_3 , and IO_3 form pyramids. R. P.

***4151. Interval Recorder for Analysis of Spectra.** G. R. Harrison. *J.O.S.A.* 28. pp. 290-292, Aug., 1938.—A device is described which automatically combs a list of wave numbers punched on a paper tape for pairs of lines having constant differences, and records the wave numbers of these pairs on kiné film. It supplements the spectrum interval sorter, which makes use of the same punched tape and automatically places all similar intervals in juxtaposition so that frequently recurring intervals can be detected. The interval recorder is set successively for the various intervals which the interval sorter chart shows to be important. When a light beam passes simultaneously through holes in both upper and lower sections of a looped portion of the tape, a photo-cell flashes an argon lamp which illuminates two wave number dials turning in synchronism with the motion of the tape, and records their readings. By means of a calibrated differential the two dials and the tape can be set for any desired wave-number difference. A. H.

***4152. Variable-Angle Liquid-Prism Spectrometer.** T. V. Starkey. *Journ. Sci. Instruments*, 15. pp. 290-292, Sept., 1938.—This paper describes a spectrometer of the auto-collimating type in which a liquid prism is used, and which is therefore especially suitable for the accurate determination of the refractive indices and dispersive powers of liquids. It is with its application to the measurement of refractive indices that this paper is chiefly concerned. AUTHOR.

See also Abstracts 3891, 3894, 3917, 4013, 4014, 4015, 4075, 4077, 4090, 4195.
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TRANSMISSION.

4153. Measurement of Velocity of Light over a Single Journey.

R. J. Clark. *Phil. Mag.* 26. pp. 361-376, *Sept.*, 1938.—It is shown that if two clocks, previously synchronised by using the known velocity of any signals over the double journey between them, are used to measure the velocity of those signals over a single journey, the result will necessarily be that the velocity over a single journey is equal to that over a double one. It is also shown that when wave trains are employed for signals, and also that the standard length employed, depends on waves of the same kind as the signals, the result may be that the measured velocity of the waves is the same in every direction. If the dimensions of material bodies depend on a mechanism involving electromagnetic waves, and if the frequency of a moving clock alters according to the classical theory of Larmor and Lorentz, then measurements made in a physical system may be as required by the restricted theory of relativity. The possibility of measuring the velocity of light over a single journey is discussed, and an outline is given of a possible method. AUTHOR.

VISION.

4154. Vision in Nature and Vision Aided by Science. (Lord) Rayleigh.

Nature, 142. pp. 327-338, *Aug.* 20, 1938. *Science*, 88. pp. 175-181, *Aug.* 26, and pp. 204-208, *Sept.* 2, 1938. *Presidential Address to the British Assoc., Cambridge, Aug.*, 1938.—The contrast and apparent discrepancy between sensual impressions and the results of modern science are briefly mentioned but it is pointed out that the senses were not primarily developed for research purposes and that it is necessary to adapt them for that purpose. An account of some of the ways in which such adaptations are made occupies the main portion of the address. The mechanism of the human eye is briefly described and is followed by a description of various artificial ways of extending its observational power. Amongst them are mentioned the use of simple lenses in spectacles and telescopes and of compound lenses in microscopes, the u.v. microscope, the electron microscope and the use of X-rays for examining atomic structure; there follows a section on colour vision with reference to the photographic plate and to photoelectricity and finally a short account is given of the principles of television. An answer is given to the indictment that science is the source of war. The feasibility of desisting from work which might have a possible application to war is discussed and examples are given in illustration. It is emphasised that the urge to explore the unknown, whether for good or ill, is deep-rooted in our nature and, although the world is prepared to accept and to use any knowledge gained, it is not ready to accept the advice of scientific men as to how such knowledge should be applied in human relations. H. J. H. S.

See also Abstract 4102.

X-RAYS.

***4155. X-Ray Tube for Crystal Analysis and Stress Measurements. J. E. de Graaf and W. J. Oosterkamp.**

Journ. Sci. Instruments, 15. pp. 293-303, *Sept.*, 1938.—The factors are discussed which determine the development of an X-ray tube for crystal analysis, *viz.*, the brightness of the focal spot, its shape and load distribution, the construction of the tube and its manipulation, and the purity of the spectrum. AUTHORS.

***4156. Technique of X-Ray Spectral Analysis.** P. Brauer. *Zeits. f. techn. Physik*, 19. 8. pp. 232-237, 1938.—The advantages of using an electrostatically screened antikathode for X-ray spectral analysis are outlined and the analysis of powdered specimens is illustrated, very short exposure times being achieved. J. T.

***4157. X-Ray Diffraction of Substances under High Pressures.** R. B. Jacobs. *Phys. Rev.* 54. pp. 325-331, Sept. 1, 1938.—An apparatus is described which may be used for X-ray diffraction work on substances under pressures up to 5000 atm. The compressive medium is He. A small (2.5 cm. radius) Debye-Scherrer type camera is used. The camera, complete with film and specimen, was placed inside the high pressure chamber. The X-rays make their entrance through a Be window in the chamber wall. A general blackening of the film by scattering from He is prevented by slits installed for this purpose, and the quality of the X-ray diffraction lines is quite good. Results are given for the transition AgI (II) to AgI (III). The crystal structure of AgI (II) is found to be cubic (NaCl type). The volume change in this transition is found to be greater when measured by X-ray methods than when measured by over-all methods. An interpretation of this is given. Some results on Cd and RbCl are also described. AUTHOR.

4158. Mass Absorption Coefficients of Monochromatic X-Rays in Water and Aqueous Solutions. I. Müller. *Ann. d. Physik.* 32. 7. pp. 625-639, Aug., 1938.—Using a source of monochromatic X-rays, the $K\alpha\alpha^1$ doublet from 28 elements from Mn (2.0988 Å) to Bi (0.1623 Å) produced by the filter difference method of Küstner, measurements of the mass absorption coefficients have been made for water and aqueous solutions of compounds of Se, Br, Cd, I, Ba, Ce and Tl, on either side of the K-absorption edge. By a compensation method, the absorption of the water and of the water of crystallisation contained in a cell of desired thickness introduced in the beam of X-rays, was taken as I_0 , so that only the absorption of the pure substance was observed. A measuring apparatus is described by which the thickness of the cell wall and of the solution could be determined with great accuracy. For water, an absorption formula $\mu/\rho = 2.5404\lambda^{3.216} + 0.21944f(\lambda)$ was determined which is in good agreement with that found by Küstner and Trübstein [see Abstract 2145 (1937)]. The results are given in tables and graphs and the linear sections on either side of absorption edge, when $\log \mu/\rho$ is plotted against $\log \lambda$, shows that the $C \cdot \lambda^n$ law is fulfilled. The transition at the K-absorption edge is shown to be $\mu_k/\mu_l = 63.868 Z^{-0.6207}$ agreeing within $\pm 4.1\%$ of the data given by Rindfleisch [see Abstract 2150 (1937)].

T. A. C.

4159. M-Series of Elements from Cd(48) to Ce(58). H. Kiessig. *Zeits. f. Physik*, 109. 9-10. pp. 671-684, 1938.—The M-series has been studied for elements from Cd to Ce, with the exception of I, X, and Cs, using a plane grating spectrometer. The Moseley diagrams are given and two new Moseley lines are discovered which are ascribed to the transitions of $M_{IV}O_{II}$ and $M_{V}O_{III}$. For La(57) the $Ma\beta$ doublet is observed although according to the Siegbahn level scheme the $N_{VI,VII}$ level is not occupied. The energy level values are calculated and the breadths of the $M\zeta$ lines measured. There appears to be a definite relation between the breadths and the periodic system of the elements. C. J. B. C.

***4160. Measurement of X-Ray Intensities with a Counter.** P. Ohlin. *Phys. Zeits.* 39. pp. 567-571, Aug. 1, 1938.—A description is VOL. XLI.—A.—1938.

given of the construction and use of a high vacuum crystal spectrograph attached to a counting tube for the measurement of small X-ray intensities. A new amplifier method of counting impulses is used and its mode of action explained. In order to illustrate the working of the apparatus the intensity distribution of the Ca K_α doublet has been measured and the results shown side by side with the photometric curves of the same lines. J. E. R.

4161. Absolute Wave-Length of $K\alpha_{1,2}$ Line of Al. F. Tyrén. *Zeits. f. Physik*, 109. 11–12. pp. 722–727, 1938.—The author has determined the absolute wave-length of the $AlK\alpha_{1,2}$ doublet with a concave grating at grazing incidence (angle of incidence 89°). The grating had a focal length of 942 cm., and there were 576 lines per mm. The value of the wave-length obtained is $8.3397 \pm 0.0003 \text{ \AA}$. This result furnishes the value $e = (4.803 \pm 0.004)10^{-10}$ e.s.u. for the unit electronic charge.

L. K.

See also Abstracts 3906, 3907, 4254, 4263.

HEAT.

CALORIMETRY.

4162. Heat Capacity of Ethylene. D. B. Pall, J. W. Broughton, and O. Maass. *Canad. J. of Research*, 16. Sect. B. pp. 230–241, July, 1938.—The heat capacity of ethylene at constant volume has been investigated through the critical range, between 6.5° and 27°C ., at an average density slightly greater than the critical. The heat capacity in the immediate neighbourhood of the critical temperature is found to be a function of the previous thermal treatment of the system. The results indicate the persistence of a large amount of molecular interaction in ethylene above the critical temperature, and are in agreement with the concept that the liquid state of aggregation can persist above the temperature at which the visible meniscus disappears. AUTHORS.

4163. Specific Heats of Beryllium, Phosphorus and Titanium Nitrides. S. Satoh. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers*, No. 810. pp. 888–896, Aug., 1938. In English.—The mean specific heat of Be_3N_2 was measured by the ice calorimeter over three temperature intervals $0^\circ \sim 99.5^\circ \text{C}$., $0^\circ \text{C.} \sim 303.3^\circ \text{C}$., $0^\circ \text{C.} \sim 500.3^\circ \text{C}$., and the equation of the true specific heat within the limit stated by the above temperature intervals is obtained: $C = 0.2726 + 7.884 \times 10^{-4}t - 5.163 \times 10^{-7}t^2$. The mean specific heat of P_3N_5 was determined by the same method over two temperature intervals $0^\circ \text{C.} \sim 99.6^\circ \text{C}$. and $0^\circ \text{C.} \sim 305.3^\circ \text{C}$., and the equation of the true specific heat within the limit stated by the above temperature ranges is obtained: $C = 0.2027 + 6.252 \times 10^{-4}t$. The mean specific heat of TiN was also determined by the same method over three temperature intervals $0^\circ \text{C.} \sim 99.6^\circ \text{C}$., $0^\circ \text{C.} \sim 305.3^\circ \text{C}$., and $0^\circ \text{C.} \sim 500.5^\circ \text{C}$., and the equation of the true specific heat within the limit stated by the above temperature intervals is obtained: $C = 0.1410 + 1.918 \times 10^{-4}t - 1.127 \times 10^{-7}t^2$. [See also Abstract 3311 (1938).] AUTHOR.

4164. Specific Heat of Nickel. C. Sykes and H. Wilkinson. *Phys. Soc., Proc.* 50. pp. 834–851, Sept. 1, 1938.—The {specific-heat, temperature} curves for four different types of Ni have been determined, VOL. XLI.—A.—1938.

and the effects of method of manufacture, heat treatment, and chemical composition have been ascertained. The results, together with those obtained by previous investigators, are reviewed, and an attempt is made to evaluate the most probable $\{C_p, T\}$ curve for nickel for the temperature range 100° C. to 600° C. AUTHORS.

CONDUCTION.

4165. Thermal Conductivities of Liquid O₂ and N₂. G. Hammann. *Ann. d. Physik*, 32. 7. pp. 593-607, Aug., 1938.—A method for the determination of thermal conductivity of liquids at low temperatures is described. The arrangement consists of a horizontal thick layer of the liquid, with a heating coil above and a cold plate below, both in contact with the liquid. Loss of heat from the sides of the layer and the top of the heating coil is prevented by means of an evacuated chamber. Thermocouples immersed in the layer of liquid record the vertical temperature fall. The apparatus is inside a Dewar flask containing liquid N₂. Observations are made during the steady state. The thermal conductivities of liquid O₂ and N₂, and of mixtures of the two liquids were determined at various temperatures within the temperature range -191.1 to -208.5° C. The values obtained at -200° C. for liquid O₂ and N₂ were 0.000498 and 0.000496 gm. cal./sec. cm.² ° C. respectively. For the mixtures, the values were lower, the least value, 0.000460 gm. cal./sec. cm.² ° C. at -200° C. being for a mixture of 45% liquid O₂ and 55% liquid N₂. These results are considered accurate to $\pm 1\%$. S. W.

CONVECTION.

See Abstract 3935.

TEMPERATURE.

4166. Attainment of Low Temperatures. C. G. Darwin. *Manchester Phil. Soc., Mem.* 82. pp. 49-66, April, 1937-1938.—An address on the history and present position of low temperature studies.

G. C. E.

***4167. Gas Thermometer for Very Low Temperatures. A. H. Woodcock.** *Canad. J. of Research*, 16. Sect. A. pp. 133-137, July, 1938.—A new form of He gas thermometer is described, which is designed for permanent installation in low-temperature equipment in order to cover the difficult region between the temperatures of liquid H₂ and of liquid He. The device departs radically from the usual gas thermometer practice by having the volume of gas which remains at room-temperature considerably larger than that of the thermometer bulb proper. It is shown theoretically that by this means the sensitivity, as compared with that of an ordinary gas thermometer with the same initial pressure and temperature, is greatly increased at the lowest temperatures. Thus it is possible to construct a thermometer which is sufficiently sensitive in the region below 20° K. to read temperatures to within 0.1° with the aid of an ordinary Hg manometer, and yet have a pressure only of the order of 1 atm. at room-temperature. An experimental test has shown that the device is entirely practicable. AUTHOR.

4168. Phenomena at the Temperature of Liquid Helium. E. F. Burton. *J. of Applied Physics*, 9. pp. 489-499, Aug., 1938.—The Kamerlingh Onnes, Simon and Kapitza methods of producing liquid He are sketched very briefly, together with the methods of reaching temperatures below 4° K. Low-temperature thermometry is touched upon

and the two states of He and the properties at the transition point are summarised. The rest of the paper deals with the supraconductive state and various electric and magnetic theorems and properties which are connected with this state.

E. H. D.

See also Abstracts 4071, 4110, 4177.

THERMOCHEMISTRY.

4169. Isotopic Effects in Heats of Dilution of Electrolyte Solutions and of Water-Dioxane-Mixtures. W. Birnthal and E. Lange. *Zeits. f. Elektrochem.* 44. pp. 679-693, Sept., 1938.—In continuation of previous work [see Abstract 4112 (1937)] on the properties of highly concentrated KF solutions, the isotopic effects on the heats of dilution of LiCl and LiBr and of certain other isotopic phenomena in the system dioxane water at 25° C. are now investigated. The paper is very comprehensive and is almost a survey of the general solution problem. Phenomena at many concentrations are described and discussed from the thermodynamic standpoint with numerous illustrative diagrams and a very complete Bibliography of 69 references. The paper should be consulted in its entirety as a valuable contribution to the present state of solution theory.

H. H. Ho.

4170. Indetermination of the Intervals and Origin of Explosion Waves. G. Wataghin. *Comptes Rendus*, 207. pp. 358-360, Aug. 8, 1938.—Recently the author has indicated that there exists a new kind of indetermination in the spacing of explosion intervals corresponding to the limitations attendant on the measurement of impulses, limitations having the nature of the forces of β -radiation. This indetermination is now formulated by means of a new algebra of quantum states, in which there is added to the complete system of operator functions for the impulse ρ (for plane waves) a finite number of quantum states represented by other functions which, in general, are not orthogonal, but which for values of ρ lower than a certain critical value, differ by only a small amount from the ordinary expressions of the quantum theory. This new method is utilised for the mathematics of explosions.

H. H. Ho.

See also Abstracts 3921, 4192.

THERMODYNAMICS.

4171. Molecular Force and Imperfect Gases. Weng Wen-Po. *Phil. Mag.* 26. pp. 225-244, Aug., 1938.—On the assumption that the force between two spherical molecules is composed of an attraction and a repulsion, each varying as an inverse power of the distance between the molecules, the force can be represented by an equation containing four constants. It is then possible to arrive at values for the two indices from experimental data for the Boyle temperature, T_b , at which the second virial coefficient vanishes, and the inversion temperature of the Joule-Thomson effect. Information regarding the law of molecular force is also obtained from a study of the corresponding states and reduced variables, since such ratios as T_b/T_c , ρ_e/ρ_c and LM/RT_c should each have constant values for molecules whose forces of attraction and repulsion obey similar power laws. ρ_e = density of liquid, ρ_c = critical density,

L = latent heat of evaporation per gm., M = molecular weight, R = gas constant and T_c = critical temperature. R. W. P.

4172. Corresponding-States Equation for General Physico-chemical Computations. F. G. Keyes. *Am. Chem. Soc., J.* 60. pp. 1761-1764, Aug., 1938.—It is shown that the recent fugacity-pressure ratio charts for constant reduced temperatures *versus* reduced pressure, taken literally, lead at low pressures to a simple reduced equation of state. The constants of this equation are deduced from the values of the van der Waals constants deduced for 13 substances by Beattie and Bridgeman. It appears that there is a distinguishable difference in the reduced-constants values for non-polar compared with polar gases. A test of the usefulness of the reduced equation is made by computing the equilibrium constants for the Haber equilibrium for high pressures and for Gillespie's experiment. In applying the equation to mixtures of gases use was made of a "constants" combination rule previously found valid for N_2 - CH_4 mixtures. The results indicate that the reduced equation is useful for making approximate physico-chemical calculations involving gases under pressure. The present reduced equations suffer from the assumption that a van der Waals type of molecular field is assumed valid, and more precise data for gases and gas mixtures at low pressures are needed before the implications deducible from the existing fugacity-pressure ratio charts can be explored satisfactorily. AUTHORS.

4173. Transformation $II \rightleftharpoons III$ of Solid H_2S and D_2S . K. Clusius and K. Weigand. *Zeits. f. Elektrochem.* 44. pp. 674-679; *Disc.*, 679, Sept., 1938.—Solid H_2S and D_2S exist in 3 modifications of which I and II are optically isotropic, while III is anisotropic. An experimental procedure is described by which the pressure displacement of the transformation $II \rightleftharpoons III$ can be followed up to 250 kg./cm². From the slope of the transformation curves, and the heats and temperatures of transformation, the volume difference of the two phases can be evaluated. The transformation $III \rightarrow II$ only produces an increase of 2.5 ± 1 per 1000 in the lattice distance, and therefore cannot follow from a dynamic equilibrium which exists between separate molecules; rather must it be assumed that only larger lattice regions can come together statistically under energetically favourable conditions. A similar mechanism may be effected in many transformations between solid phases. The discussion deals mainly with sizes of crystals. H. H. Ho.

4174. Nernst Heat Theorem and Irreversible Processes at Low Temperatures. A. R. Ubbelohde. *Phil. Mag.* 26. pp. 260-268, Aug., 1938.—The author examines the extension of the heat theorem in some detail and deals with the following divisions of the subject: (1) Application of thermodynamics to spontaneous charge, (2) the use of thermodynamic variables in describing irreversible processes, (3) experimental examples of the application of the heat theorem to irreversible processes at low temperatures—electrical resistance, thermal conductivity and viscosity. Although further experimental evidence is required before the scope of the proposed extension of the Nernst heat theorem can be properly estimated, the conclusions arrived at in this paper are of sufficient interest to support the attempt to classify irreversible processes at low temperatures from this point of view. The paper should be consulted in its entirety. H. H. Ho.

4175. Entropies of Aqueous Ions. W. M. Latimer, K. S. Pitzer and W. V. Smith. *Am. Chem. Soc., J.* 60. pp. 1829-1831, Aug., 1938.—

The calculation of the entropies of aqueous ions have been completely revised and extended to include eleven additional ions. AUTHORS.

See also Abstracts 3921, 3966, 4099, 4126, 4127, 4177.

VAPORISATION AND CONDENSATION.

4176. Vaporisation Coefficient of Water. H. Mache. *Zeits. f. Physik*, 110. 3-4. pp. 189-196, 1938.—The vaporisation coefficient is defined to be the rate, in cm./sec., at which the surface of water falls by evaporation, provided the vapour pressure of the immediate gas or vapour layer is kept constant at about 1 mm. of Hg below the saturation pressure corresponding to the temperature of the water at its surface. Previously [see Abstract 5387 (1937)] the author has described two processes for the determination of the vaporisation coefficient of water, which, however, gave merely the order of the coefficient, as it was found that the value of the coefficient depended to a large extent on the condition of the water surface. In the present series of experiments, the water is superheated as before, but the evaporation takes place at freshly formed clean water surfaces, and into pure water vapour. Larger values of the vaporisation coefficient than those obtained previously are observed. S. W.

4177. Peculiarities in Liquefaction of Helium. I. L. Zelmanov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 6-7. pp. 469-470, 1938. *In English.*—The well-known T-S diagram published by Keesom and Hanthoff, designed to solve unambiguously the problem of the liquefaction coefficient for any case whatever, does not afford an explanation of the maximum observed by K. Onnes at 20 atm. pressure for He, and this discrepancy was held by Kapitza to be due to inexactitude of the diagram. It is now shown by a consideration of the T-S diagram that the above discrepancy may be merely an apparent one and result from an inaccurate calculation of the liquefaction coefficient, since the latter is not determined unambiguously by the drop of the enthalpy on the hot end of the heat-exchanges but depends also upon the course of the isenthalpies in the region of the diagram adjacent to the boundary curve of the liquid. The introduction into the scheme of the liquifier of an additional throttle-valve is shown to solve the problem. H. H. Ho.

4178. Activity Coefficient of CoCl_2 in Aqueous Solution. R. A. Robinson. *Faraday Soc., Trans.* 34. pp. 1142-1143, Sept., 1938.—The activity coefficient of CoCl_2 in aqueous solution between 0.05 and 2 M has been determined at 25° by the isopiestic vapour pressure method. The results may be interpreted tentatively as indicating complete dissociation of the salt as in the case of the chlorides of the alkaline earth metals and in contrast to the chlorides of Zn, Cd and Hg. AUTHOR.

See also Abstract 3966.

ACOUSTICS.

4179. Effect of Ultrasonic Vibrations on the Discharge Potential of Hydrogen. R. Piontelli. *Accad. Lincei, Atti*, 27. pp. 357-363, April 3, 1938.—A 250 W quartz generator, $n = 1.196 \times 10^6$, is used with vertical Hildebrand Pt electrode in cylindrical glass tube 2.6×2.45 cm., with calomel electrode for collection; voltage is measured by a sensitive potentiometer galvanometer, and current by a Weston milliammeter. Circulation of the electrolyte is found to have a marked effect on voltage, especially at low current density, so that strictly reproducible conditions must be used. After equilibrium is established p.d. is measured, the vibration is then applied and the measurement repeated, in general a marked depolarisation sets in up to 0.8 V. Current/p.d. curves reproduced for 0.1 N KCl and NaOH are approximately hyperbolic. The author suggests that at low current density it is probably deabsorption which decides the cathodic potential under ordinary conditions; after passing the region of complete saturation this transforms into the Gurney phenomenon characteristic of acid solutions, in which electrons cannot penetrate the electrode surface, and it is probably this which then determines the cathodic potential. Ultrasonic vibration will remove deposited products from the electrode surface; it is noteworthy that when gas is freely evolved the action of ultrasonics is not so marked. The discharge potential phenomenon is therefore comparable with double layer action or indeed to a special type of chemical action. [See also Abstract 4629 (1937).] D. R. H.

4180. Supersonic Measurement of Adiabatic Elasticity of Crystals. E. Baumgardt. *Comptes Rendus*, 207. pp. 273-274, July 25, 1938.—A method is proposed by which the three moduli of adiabatic elasticity of a crystal may be determined. The wave-length of the supersonic waves employed is to be measured for laminae cut along three different directions from a crystal belonging, say, to the cubic system, using the frequencies at which the laminae are most transparent [see Abstract 2958 (1938)]. The three moduli of the crystal can then be calculated. G. E. A.

4181. Dispersion of Solids in Liquids by Supersonic Waves. K. Söllner. *Faraday Soc., Trans.* 34. pp. 1170-1174, Sept., 1938.—Solid bodies of low cohesion, e.g., mica, steatite, gypsum, graphite, sulphur, haematite are dispersed in liquids by the action of supersonic waves. The dispersions so obtained contain many particles of semi-colloidal and colloidal size. The particles of suspensions and sols are also subject to further disintegration when irradiated with supersonics of high energy. This process is sometimes particularly effective and rapid. Solid metals, owing to their high cohesion and high ductility, have not, thus far, been dispersed by supersonics. AUTHOR.

4182. Supersonic Waves as Optical Shutter. O. Maercks. *Zeits. f. Physik*, 109. 9-10. pp. 598-605, 1938.—A method is developed in which the diffraction of light by standing sound waves in liquids is used for modulating the intensity of the light. It is possible to obtain satisfactory modulation at frequencies up to 10^7 ~, provided sufficient care is taken to make the sound wave field uniform. R. P.

4183. Supersonic Interference Method of Measuring the Velocity of Sound. J. P. Cance. *J. de Physique et le Radium*, 9. pp. 308-312, July, 1938.—When two supersonic plane waves are propagated through VOL. XLI.—A.—1938.

a liquid and reach the surface, they give rise to interference effects in the surface common to the two beams which are analogous to the distribution of luminous intensity given by Fresnel's biprism. There are formed, along the equidistant lines of maximum tension, immobile ridges raised above the surface of the liquid, with corresponding troughs between. In carrying out measurements the two plane waves were furnished by quartz crystal plates of dimensions $50 \times 25 \times 1.5$ mm., having a natural frequency of about 2000 kc/s. Measurements of the distance apart of the ridges gave for toluene, water and Hg, results for the velocity of sound in close agreement with those of other workers. A. W.

4184. Sound Velocity in D_2O and its Compressibility. K. Yosioka. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No. 806. pp. 843-853, Aug., 1938. In English.*—The velocity of sound both in H_2O and in D_2O of $d_{25}^{25} = 1.106_4$ was determined at temperatures between 25° C. and 90° C. at a frequency of 4900 kc./sec. by the method utilising the diffraction of light. The relation between the sound velocity and the temperature was found to be similar in both cases. The temperature at which the sound velocity becomes maximum is higher in D_2O than in H_2O . The relation between the adiabatic compressibility and the temperature was found also to be similar in both cases. The temperature at which the adiabatic compressibility becomes minimum is also higher in D_2O than in H_2O . At 25.0° C., the sound velocity in pure D_2O was found by extrapolation to be 1.398_6 m. sec $^{-1}$, the adiabatic compressibility and the isothermal compressibility of pure D_2O $46.2_7 \times 10^{-12}$ dyne $^{-1}$ and $46.4_9 \times 10^{-12}$ dyne $^{-1}$ respectively. AUTHOR.

4185. Velocity of Supersonic Waves in Liquid Oxygen. H. W. Liepmann. *Helv. Phys. Acta*, 11. 5. pp. 381-396, 1938. *In German.*—Apparatus described in an earlier paper [see Abstract 5215 (1936)] is improved to enable absolute values of the velocity of supersonic waves in liquid O_2 to be obtained, the Debye-Sears effect being used. The boiling point of liquid O_2 is varied from -183.6° to -210° by rapid pumping. Between these two temperatures the velocity of waves of frequency about $10^6 \sim$ increases approximately linearly with decreasing temperature from 911 to 1130 m/sec. The corresponding adiabatic and isothermal compressibilities are calculated. K. M. C.

4186. Transmission of Supersonic Waves Through Thin Sheets. R. Bär. *Helv. Phys. Acta*, 11. 5. pp. 397-407, 1938. *In German.*—The author extends the mathematical analysis [see Abstracts 1813 and 1814 (1938)] of the transmission of waves through thin sheets. It is recalled that when compression waves fall on a thin sheet immersed in a fluid, in general, both compression waves and flexural waves are excited in the sheet. Four simple special cases are now dealt with: (1) only compression waves are produced in the sheet; this is the case of perpendicular incidence, dealt with by Rayleigh, (2) only flexural waves are produced in the sheet; this occurs when the angle of refraction of flexural waves is 45° , (3) only one refracted compression wave is produced, which by internal reflection at the second surface is converted to a flexural wave, and (4) the converse case when only one refracted flexural wave is produced which is converted to a compression wave. In cases (3) and (4) the angles of incidence and sheet thickness are such that the transmission is unity. K. M. C.

4187. Transmission of Supersonic Waves Through a Rigid Sheet. F. Levi and N. S. N. Nath. *Helv. Phys. Acta*, 11. 5. pp. 408-431, 1938. *In German*.—Following a paper of Reissner [see Abstract 1814 (1938)] the transmission of waves through a rigid sheet immersed in a fluid is analysed and Reissner's general results are confirmed, although a different method is used. Total reflection is also dealt with. K. M. C.

4188. Masking Effect of Noise and the Mechanism of Hearing. H. Fletcher. *Nat. Acad. Sci., Proc.* 24. pp. 265-274, July, 1938.—The fluctuating voltage due to thermal motion of the electrons in a conductor is used to obtain a noise having a continuous spectrum. A broad frequency band of this noise, whose spectrum level is known at each frequency, is impressed upon the ear of an observer, while a pure tone of known frequency is raised to such an intensity that its presence can just be detected. It is found that the intensity of the pure tone is greater at high frequencies than low, indicating that the stimulation per nerve is not so great at low frequencies, so that the stimulus must be spread out over a greater number of nerve endings. It is assumed that the nerve endings which respond to a given frequency can be specified by their distance from the tip of the basilar membrane, and by a development of the above result this distance is evaluated for the whole of the auditory range. K. M. C.

See also Abstracts 3922, 3947, 3948, 3984, 4094 and

2967 and 2968B. Reduction of Structure-Borne Noise by Vibration-Attenuating Supports. A. J. King.

3008B. Vibration of Power Lines in Steady Wind. R. Ruedy.

3116B. Forced Vibration of Circular Membrane, Plate, or Hollow Sphere. M. Matudaira and T. Hayasaka.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

4189. Kirchhoff Constraints and Sagittal Graphs. W. H. Ingram. *Phil. Mag.* 26. pp. 268-271, Aug., 1938.—From the dynamical view-point the graph (*i.e.*, the topological diagram) of an electric net is regarded as a representation either (1) of the constraints on, or (2) of the orthogonality of the coordinates according as they are, or are not, subject to conditions of constraint. In the first case the line segments of which the graph is composed have sense, in contradistinction to the second case. The two cases imply each other and are distinguished as sagittal and neutral respectively. The sagittal graph is not transformable to a geometrically different graph by any non-singular transformation of the dynamical variables (local currents), and does not exist for most variables thus related to the original, *e.g.*, variables related to the original by linear equations with irrational coefficients. On the other hand, the neutral graph may be transformed under certain circumstances to a geometrically different figure. Examples of graphs are discussed, and it is proved, from the more fundamental viewpoint now adopted, that currents not subject to Kirchhoff's law flow in circuits. H. H. Ho.

See also Abstract

2908B. Owen Inductance Bridge. T. Walcher.

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CONDUCTION AND DISCHARGE IN GASES.

4190. Generalisation of the Theory of Electrical Discharges. J. S. Townsend and E. W. B. Gill. *Phil. Mag.* 26. pp. 290–311, Aug., 1938.—The author's well-known general collision theory of the actions of electrons and positive ions in discharges is now extended to cover different kinds of discharges in gases at low pressures, and the conditions are investigated as to how the electric forces required to maintain the discharges are effected by a magnetic force. The most convenient method was found to be a comparison of the motion of electrons or the rate of ionisation under various conditions with the motion or rate of ionisation in a uniform electric field where there is no magnetic force. The theoretical results obtained have been tested experimentally by measuring the electric force required to start a discharge in dry air in a large spherical bulb.

H. H. Ho.

4191. Point to Plane Discharge in Air. A. F. Kip. *Phys. Rev.* 54. pp. 139–146, July 15, 1938.—A comprehensive series of experiments have been carried out on the current-voltage characteristics of a positive point to plane discharge in dry air. It is shown that all currents start abruptly and increase at firstly linearly and then more steeply with voltage until spark breakdown occurs. Fields at onset were calculated by the use of confocal paraboloids as electrodes. Introduction of a radioactive source into the gap shows that the sharp cut off of the corona current at lower voltages is due to lack of electrons. The initial current rise is found to increase as the gap separation is decreased. The curves are analysed in detail and explanations suggested for the various stages of the discharge process.

J. E. R.

4192. Explosive Potential in Benzene. E. Badereu. *Comptes Rendus*, 207. pp. 279–281, July 25, 1938.—This paper describes a theoretical development of the experimental results previously obtained [see Abstract 3798 (1938)]. He shows that $V_{\min.}/(pd)_{\min.} = (E/p)_0$ where E is the intensity of the electric field and p the gas pressure, the suffix 0 representing the values corresponding to the minimum in the Townsend curve, i.e., to $\eta_{\min.}$, the minimum energy expended by an electron in causing ionisation in the gas. The value of $\eta_{\min.}$ is comparatively large showing that more energy is required to cause ionisation in benzene than in simpler gases. The value is about 2000 as compared with 203 for H_2 , 940 for O_2 and 822 for CO_2 . This high value is related to the many possibilities of energy absorption in benzene—rotation, vibration, dissociation, etc. It is also connected with the fact that a large number of ions are needed for the production of the discharge.

G. G.

4193. Townsend Ionisation Factor γ . R. Schöfer. *Zeits. f. Physik*, 110. 1–2. pp. 21–36, 1938.—Accurate striking potential measurements between electrodes of various materials in A have been made in order to calculate the Townsend ionisation factor γ in the striking formula $\gamma(e^{ad} - 1) = 1$. By varying the electrode spacing and the gas pressure, the dependence of γ on field strength and pressure has been determined. For Ni and Fe the factor is small and almost constant; for Ba and Mg it starts at a higher value, increases rapidly with increasing E/p_0 and then increases much more slowly. Further measurements in A, H_2 and air, using cylindrical electrodes with radii in the ratio 1:2 indicate very small variations with current direction, but larger variations with field strength. The theory put forward by Schade concerning the changes in discharge

current when the ion concentration in the gas is increased has been investigated. From measurements of the striking current and the lowering of striking voltage during irradiation of the discharge tube values of γ have been determined and found to be in good agreement with those calculated from the striking potentials. J. E. R.

4194. Striated Positive Column. Part I. Pure Hydrogen. A. Güntherschulze and H. Meinhardt. *Zeits. f. Physik*, 110. 1-2. pp. 95-117, 1938.—The current strength for which the unstriated discharge passes over to the striated discharge can be measured very accurately. It is found to be an exponential function of the pressure. From this function it is seen that the striated discharge in pure H_2 should be possible when the current strength is high enough to build up a space charge which accelerates the electrons up to about six free path lengths and gives ample ionisation. With further increase of current strength the layer distance and layer p.d. rapidly decreases, for which an explanation is given. For another quite definite and measurable current strength the uniformly striated discharge suddenly becomes non-uniform and pairs of striæ occur. The current strength at which this occurs follows very closely the law $i = C.p^3$. With still further increase of current strength there is a gradual change to a different type of single striæ. Illustrations are given of the effects obtained under various conditions of current and pressure in tubes of carefully prepared pure H_2 . A. W.

4195. Influence of Tube Diameter on Concentration of Excited States in the Positive Column. W. Dirbach and K. Krebs. *Zeits. f. Physik*, 110. 1-2. pp. 134-144, 1938.—A neon discharge tube of varying diameter has been used to estimate by a previous method [see Abstract 4183 (1936)] the concentration of harmonic oscillators of different frequencies. The concentration increases with decreasing diameter and this, in conjunction with minor corrections, accounts for earlier discrepancies. G. C. E.

4196. Influence of the Ramsauer Effect on the Potential Gradient in a Positive Column. B. Klarfeld. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 6-7. pp. 471-474, 1938. *In English.*—Discharges in He, Ne, A, Kr, Hg vapour and K vapour were investigated to find out how the potential gradient in the positive column varies with pressure in general. The gradient was measured by the zero-current probe method in tubes of 20 mm. dia., the discharge currents ranging from 25 to 300 mA. The results obtained for He, Ne, A and Kr with a current of 0.3 A are qualitatively similar and change continuously in one direction on passing from the light to the heavier inert gases. The gradient minimum, at pressures of about 1 mm. of Hg, is deeper in the heavier rare gases. This fact may possibly be attributed to the Ramsauer effect, which is more pronounced in the heavier rare gases. Calculated gradients for He and A agree fairly well with the observed gradients. The absence of a gradient minimum in He and in K vapour may possibly be connected with a decrease of the effective cross-section of He and K atoms with increasing electron velocity. In Hg vapour a slight minimum of the potential gradient is observed. It is pointed out that earlier measurements of the potential gradient and of the values of T_e and B in Hg vapour would be in better agreement if for Hg there existed a Ramsauer effect for electrons of very low velocities. [See also Abstract 2754 (1937).] A. W.

4197. Characteristics of Glow to Arc Transition in Mercury Vapour. F. A. Maxfield and G. L. Fredendall. *J. of Applied Physics*, 9. pp. 600-610, Sept., 1938.—The probability of the transition from glow discharge to arc discharge at graphite electrodes has been investigated under carefully controlled kathode conditions. The transition probability was found to increase in an approximately linear fashion with an increase in kathode current density and glow voltage. The curve of transition probability as a function of kathode temperature was found to have a distinct maximum at a temperature of about 400° or 450° C. The probability of the transition occurring at temperatures 50° lower or higher was not more than about one-fourth the maximum. It was also found that the frequency with which the glow to arc transitions occurred depended greatly on the previous history of the discharge and the amount of high voltage positive ion bombardment experienced by the kathode under test. A possible explanation of these results has been based on the hypothesis that it is never possible to de-gas completely the kathode electrode even after prolonged operation in a high voltage discharge. It has been shown that the non-uniform emission of this gas from the kathode in the form of bursts from minute patches can lead to a greatly increased probability for transition from glow to arc. AUTHORS.

4198. Excitation of Metastable Atoms in a Gas Discharge. V. Fabrikant. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 5. pp. 385-388, 1938. *In English*.—Continuing previous work [see Abstracts 4567 (1937) and 1307 (1938)] an attempt is made to evolve a general theory of the excitation of atoms in the gas discharge. Two limiting cases are considered, the first corresponding to the destruction of metastable states by various mixtures and the second to discharges with high current densities in pure vapours and gases. Agreement between theory and experiment is satisfactory. [See following Abstract.] F. C. C.

4199. Excitation of Radiating Atoms in a Gas Discharge. V. Fabrikant. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 5. pp. 389-392, 1938. *In English*.—The results [see preceding Abstract] on metastable atoms are applied to radiating atoms. The latter are also influenced by diffusion so that extension of the theory is only approximate. However, it is found possible to draw several conclusions on the influence of discharge conditions upon the excitation of radiating atoms. For example, it is shown that the "prisoning" of radiation is one of the main factors determining the quenching of radiating atoms in a discharge. F. C. C.

4200. Relativity Corrections for the Ionisation Potential of Atoms with Two Electrons. H. A. S. Eriksson. *Zeits. f. Physik*, 109. 11-12. pp. 762-773, 1938.—The relativity corrections for the ionisation potential of an atom consisting of a nucleus of arbitrary atomic number Z and two electrons is given in the form of an expansion in powers of $1/Z$. For $Z = 2$ and 3 (He I and Li II) this formula converges too slowly and is replaced by a numerical evaluation. The results are in satisfactory agreement with experiment. R. P.

4201. Transverse Field for Positive and Neutral Rays. E. Persico and A. Rostagni. *Accad. Sci. Torino, Atti*, 73. Disp. 3a. pp. 363-368, April-June, 1938.—The mathematical results obtained in previous work [see Abstract 1272 (1938)] are applied to the experimental work of the author and others. Qualitative, and in some cases, quantitative agreement is obtained. F. C. C.

4202. Interference of Light from Canal Rays. H. Billing. *Ann. d. Physik*, 32. 7. pp. 577-592, Aug., 1938.—An apparatus is described for producing a visible canal ray consisting of a homogeneous beam of H_3^+ ions. Interferometric observations with a Fabry-Perot instrument which is arranged to view the discharge in a longitudinal direction show that interference is obtainable from two different points of the canal ray. The classical wave theory is capable of giving a quantitative explanation although wave-mechanical principles are not violated. H. J. H. S.

***4203. Gas Current H.V. Generators.** M. Pauthenier. *Comptes Rendus*, 207. pp. 126-129, July, 11, 1938.—The results hitherto obtained are discussed, and an improved arrangement, especially of the elbows of the tubes, sketched, by which it is hoped to obtain several kilowatts at 2 mV. [See Abstracts 2543 and 2975 (1938).] C. A. S.

See also Abstracts 3961, 4064, 4065, 4066, 4067, 4068, 4160, 4232 and 2878B. Emission of Light in the Positive Column at Low Pressure. W. Uytendhoeven.

CONDUCTION IN SOLIDS AND LIQUIDS.

4204. Effect of Cold Working and Heat Treatment on the Electric and Magnetic Properties of Pure Nickel. Part II. Twisted and Stretched Nickel. H. Bittel. *Ann. d. Physik*, 32. 7. pp. 608-624, Aug., 1938.—A report of measurements of resistance and magnetisation of wires of carbonyl nickel subjected to elastic and plastic deformation and to different heat treatments. Among the results given are the following. Elastic torsion increases the resistance, but if the torsion takes place in a strong enough field, the change of resistance is very small. If the wire is twisted in a weaker field, there may be an increase or decrease of resistance depending on the field strength. The effect can be explained on Becker's theory. The change of resistance in parallel and perpendicular fields was observed in wires twisted elastically and plastically; plastic torsion does not produce magnetic anisotropy. In contrast to the effect caused by other modes of cold working, the specific resistance is very little changed by plastic torsion. After cold working, recovery of magnetic and electric properties begins at the same temperature. The temperature of recovery is lowered by additional cold working. [For Part I see Abstract 1709 (1938).] G. E. A.

4205. Coexistence of Normal and Supraconductive Regions. K. Mendelssohn and J. G. Daunt. *Phil. Mag.* 26. pp. 376-380, Sept., 1938.—It is shown that an isothermal coexistence of supraconductive and normal material can occur in the same specimen. The time effects in supraconductors are discussed with regard to such a coexistence.

AUTHORS.

4206. Conductivity of Transition Metals. A. H. Wilson. *Roy. Soc., Proc.* 167A. pp. 580-593, Sept. 23, 1938.—By using a model in which the energy surfaces are spheres, a complete theory is worked out of the s - d transitions in a metal containing incomplete d -bands. The results are of the same order of magnitude as those given by Mott's qualitative theory, but differ considerably in detail and in interpretation. It is shown that the s - d transitions should fall off exponentially as the temperature is lowered. A suggestion is put forward to explain the change in sign of the thermoelectric power of Pt at low temperatures. AUTHOR.

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4207. Conductivity and Dielectric Constants of Crystals. M. G. Rahimi. *J. de Physique et le Radium*, 9. pp. 291–296, July, 1938.—In measuring the conductivities the Curie electrometer was used; the crystal was placed in an electric furnace suitable for the gradual raising of the temperature. This temperature was measured by means of a thermocouple. Quartz slabs cut perpendicular and parallel to the axis were studied. In the case of the perpendicularly cut slabs a prolonged heating at 700° C. greatly diminishes the conductivity shown by the crystal in the cold, and this diminution is still greater if the crystal remains under tension whilst being heated. By coating the crystals with Pd, Pt or Ag a condenser arrangement could be set up for the study of the dielectric capacity. Different methods—electrostatic, electromagnetic, and resonance—were used to measure the dielectric constant. The heat treatment seems to make various anomalies in the dielectric properties of quartz disappear. The thermal and electrical treatment also seems to cause quartz to assume a more well-defined state. Other crystals, including those of rock salt, were studied with similar results. G. G.

***4208. Micro-Method for Measuring Specific Conductance.** P. A. Walker. *Science*, 88. pp. 63–64, July 15, 1938.—An apparatus is designed for the measurement of specific conductances of extra-embryonic fluids of the developing chick. The apparatus is constructed of tubing 0.3 cm. internal dia., made of Jena glass. The electrodes consist of tight coils of Pt wire, having an area of about 1 mm². Conductances can be measured with as little as 0.1 cm³. The cell was standardised by measuring the conductance of 0.1 N KCl. After correction of the results for polarisation the percentage error was found to be 0.346%. F. J. B.

See also Abstracts 3904, 3905, 3906, 4168, 4233.

DIELECTRICS AND CAPACITANCE.

***4209. Molecular Models of Dielectrics.** L. Hartshorn. *Phys. Soc., Proc.* 50. pp. 852–855, Sept. 1, 1938.—Describes a cheap and simple method of construction of molecular models of complicated organic compounds such as the synthetic resins. The units of the structure are made from commercial "ball-feet" which merely require drilling in a simple jig. Models of phenol-formaldehyde resins, polystyrene and chlorinated rubber are illustrated. L. H.

4210. Dipole Moments of Vapours. Part VII. L. G. Groves. *Chem. Soc., J.* pp. 1195–1196, Aug., 1938.—On the basis of values for the moments of the C–Cl and the C–H link obtained from the moment of methyl chloride, it is shown, after allowances are made for components of induction, that the Cl–C–Cl intercovalency angle is approximately tetrahedral in both chloroform and methylene chloride. This result is in accord with the electron-diffraction results of Sutton and Brockway [see Abstract 1908 (1935)]. [For Part VI see Abstract 829 (1938).] AUTHOR.

4211. Change in Dielectric Constant at Freezing Point of Homopolar Liquids. R. Guillien. *Comptes Rendus*, 207. pp. 393–395, Aug. 17, 1938.—The dielectric constant of N₂ was plotted against temperature for the interval 55–80° K. It steadily increases as temperature falls, from 1.4318 at 78° K. to 1.4746 at 63.3° K.; then increases suddenly, in freezing, to 1.514, after which it increases slowly as temperature falls further. The apparent decrease in that of the solid as tempera-

ture falls is due to contraction of the solid between the armatures of the condenser. [See Abstract 1521 (1927).] C. A. S.

4212. Dielectric Constant of Pure Organic Liquids. R. J. W. Le Fèvre. *Faraday Soc., Trans.* 34. pp. 1127-1132, Sept., 1938.—A convenient type of apparatus for dielectric constant measurements at various temperatures is described, results recorded, and the experimental indication noted that all liquids apparently have roughly the same dielectric constant at their critical points. AUTHOR.

4213. Dipole Moments and Molecular Structure. E. Bergmann and A. Weizmann. *Am. Chem. Soc., J.* 60. pp. 1801-1804, Aug., 1938.—Dipole moment measurements reveal that the addition of chlorine to 1,5-dichloroanthracene and 9,10-diphenylanthracene is a *cis* reaction; it is suggested that, in contradistinction to the usual behaviour, the chlorine molecule is added. 1,8-Dichloroanthracene adds chlorine in *trans* reaction. The splitting reactions of anthracene-9,10-dihalides show no recognisable regularity. Hydrolysis of 1,5-dichloroanthracene-9,10-dibromide, is accompanied, at least partially, by Walden inversion; the dipole moment of the corresponding *cis* diol has been measured. On the basis of the dipole moments, the spatial arrangement of the isomeric dimethyl 9,10-dihydroanthracene-9,10-dicarboxylates has been determined. AUTHORS.

See also Abstract 4207.

ELECTROCHEMISTRY.

4214. Active Aluminium Obtained by Electrolysis at Elevated Temperature. A. Chrétien and J. Bisch. *Comptes Rendus*, 207. pp. 237-239, July 18, 1938.—Al in an extremely active form was obtained by the electrolysis of aluminium potassium bromide, using a Hg kathode. The electrolysis was carried out in a steel bomb under pressure. This was necessary owing to the boiling point of aluminium bromide being 270° C., and the electrolysis was carried out at 500° C. After the electrolysis had proceeded for 1 hr. the Hg was removed from the apparatus and divided into two portions. One portion, exposed to carefully dried air, became covered with a layer of alumina in light flakes, the other portion, under the action of water, separated a deposit of alumina in an extremely fine state of division. F. J. B.

4215. Electrolytic Dissociation of Cadmium Iodide. Y. Doucet. *Comptes Rendus*, 207. pp. 362-364, Aug. 8, 1938.—The lowering of the freezing point of molten $\text{CaCl}_2 \cdot 6\text{H}_2\text{O}$ by CdI_2 has been investigated. The curve of molecular depression against the molarity (M) of the solution falls rapidly as M increases. Extrapolation gives a limiting molecular depression equal to twice the value for the solvent so that there would be dissociation into two ions at fairly high concentrations. The results were verified by determining the e.m.f. of the cell $\text{CdHg}|\text{CdSO}_4, \text{MgSO}_4|\text{KCl sat.}|\text{CdI}_2, \text{CaCl}_2|\text{CdHg}$. A cryoscopic investigation of the $\text{KNO}_3, \text{H}_2\text{O}, \text{CdI}_2$ system has also been made. The conclusion is reached that CdI_2 probably exists in solutions of medium concentration as Cd^{++} and $(\text{CdI}_4)^{-}$ ions, but in dilute solution it dissociates into six ions corresponding to the formula Cd_2I_4 . A. J. M.

4216. Exchange Forces and Electrostatic Forces between Ions in Solution. R. W. Gurney. *J. Chem. Phys.* 6. pp. 499-505, Sept., 1938.—Though the treatment of ionic dissociation by thermodynamic methods has been fruitful, the mechanism can be better understood by

the use of statistical mechanics. For this purpose one needs to know the potential energy of the ions as a function of temperature. The work D required to dissociate a molecule or molecular ion consists of two parts, one part D_{el} due to electrostatic forces, and the other D_{non} due to non-electrostatic forces. As the former varies rapidly with temperature, for each species the value of dD/dT is a guide to the value of D_{el} . It is shown that for acid molecules and molecular ions in aqueous solution the relative values of dD/dT for different types are in the order predicted. Further, the characteristic temperature θ at which the dissociation constant passes through a maximum should depend, not on the value of D , but on the relative magnitudes of D_{non} and D_{el} . It is found that the known values of θ fall into line in accordance with this rule. Between two Hg^+ ions, or two Te^- ions, there will be exchange forces of attraction similar to those which give rise to the molecules Na_2 and Br_2 ; thus in aqueous solution the ions $(Hg_2)^{++}$ and $(Te_2)^{-}$ are stable, although for them D_{el} is negative.

AUTHOR.

4217. Electrostatic Influence of Substituents on Dissociation Constants of Organic Acids. Parts I and II. J. G. Kirkwood and F. H. Westheimer. *J. Chem. Phys.* 6. pp. 506-517, Sept., 1938.—In Part I Bjerrum's theory of the influence of substituents on dissociation constants has been extended and amplified. The molecules and ions entering into the ionisation equilibria are treated as cavities of low dielectric constant, rather than as structureless regions of the same dielectric constant as the solvent. The theory gives better results than the simple Bjerrum formulation, especially for the short chain dicarboxylic acids, and in the fact that it permits a satisfactory treatment of the influence of dipolar substituents on dissociation constants. In Part II the theory of the influence of substituents on dissociation constants is extended to acids ellipsoidal in shape. Bjerrum's formula is obtained in the limiting case of unit eccentricity of the elliptical section of a prolate ellipsoid of revolution. The influence of dipolar as well as ionic substituents can satisfactorily be treated.

AUTHORS.

4218. Influence of Degree of Ionisation on Structure of Beilby Layer—Electrolyte Passage. F. J. Taboury. *Comptes Rendus*, 207. pp. 138-140, July 11, 1938.—The influence as regards the discharge curves of the degree of ionisation of the electrolyte in which this passage layer is plunged, is discussed. The effect of conductivity water is approximately the same as that of concentrated H_2SO_4 , both being practically non-ionised. This effect differs greatly from that of the almost completely ionised dilute H_2SO_4 . The extent of this influence varies at approximately the same rate as the degree of ionisation as indicated by the Raman spectrum. [See Abstract 3826 (1938).]

C. A. S.

4219. Effects of Solvents on Polarographic Wave Heights. E. S. Peracchio and V. W. Meloche. *Am. Chem. Soc., J.* 60. pp. 1770-1775, Aug., 1938.—Polarograms are shown for $NaCl$, KCl , $RbCl$ and $CsCl$ in aqueous solutions and differences in wave height are shown to exist for equivalent concentrations of the chlorides. Contrary to indications in the literature, it is shown that equivalent concentrations of $CdCl_2$, $BiCl_3$, and $PbCl_2$ do not give equal wave heights. It is shown that the presence of various alcohols lowers the wave heights exhibited in aqueous solutions. Differences between the wave heights for equivalent concentrations of alkali chlorides are lessened. Addition of certain polyhydric alcohols to aqueous solutions of the alkali chlorides also lowered the wave heights

but in cases of the more viscous solutions the curves were poorly defined. When dioxane was added to aqueous solutions of the alkali chlorides, the wave heights for equivalent concentrations of the salts were the same. Although the shape of the curves was not ideal, the wave heights could be measured and the curves were suitable for quantitative analysis. While the universal use of organic solvents in solutions prepared for the polarograph is not recommended, there are many cases where the use of such systems is desirable and in some cases even mandatory. **AUTHORS.**

4220. Adsorption and Desorption of Hydrogen at Platinum Electrodes. J. D. Pearson and J. A. V. Butler. *Faraday Soc., Trans.* 34. pp. 1163-1170, Sept., 1938.—The changes of potential of Pt electrodes on anodic and cathodic polarisation have been investigated with high current densities using a kathode-ray oscillograph. At active electrodes it is shown that an adsorbed film of atomic H is formed prior to the liberation of H_2 at the kathode, and is removed by anodic treatment at potentials more positive than the reversible H_2 -potential. [See also Abstract 5267 (1936).] **AUTHORS.**

4221. Potential of Cd/Cd⁺⁺ in Very Dilute Solutions. F. Müller and W. Dürichen. *Zeits. f. phys. Chem.* 182. Abt.A. 4. pp. 233-242, 1938.—It is pointed out that previous work on the determination of the potential of Cd electrodes in very dilute solutions of Cd salts may have been vitiated by the fact that air was not rigorously excluded from the electrodes. Absorbed O_2 can set up local action, $Cd(OH)_2$ being formed, giving rise to Cd^{++} in the solution, and hence an incorrect electrode potential. The potential has now been determined with Cd electrodes specially purified in a high vacuum. The concentration of the $CdSO_4$ solutions used was from 1 to 10^{-7} gm.-equivalents/l. **A. J. M.**

4222. Flow Phenomena at Mercury Kathodes. M. v. Stackeberg, H. J. Antweiler and L. Kieselbach. *Zeits. f. Elektrochem.* 44. pp. 663-673; *Disc.*, 674, Sept., 1938.—Flow phenomena at static Hg kathodes are investigated in connection with polarographic maxima. Such flows occur when an easily reducible substance is electrolysed in the presence of a kation which is reducible with difficulty. A tangential force to the flow is found to act at the kathode surface in a direction determined by the current density and the signs of the charges on the kathode double layer. Variations in electrolyte concentration have been shown to produce corresponding variations of the kathode potential. The phenomena are explained by the aid of current-tension curves and kathode potential tension curves. The discussion deals mainly with experimental technique. **H. H. Ho.**

See also Abstracts 3899, 3920, 4178, 4179.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

4223. New Precision Method for the Determination of e/m for Electrons. A. E. Shaw. *Phys. Rev.* 54. pp. 193-209, Aug. 1, 1938.—Crossed electric and magnetic fields have been used in a method which effectively eliminates the influence of electron energy on the value of e/m . Errors due to charging of the slits which may rise to 24 V are thus avoided and e/m_0 is found to be $(1.7571 \pm 0.0013) \times 10^{-7}$ e.m.u. The mechanical accuracy of the cylindrical condenser sets the precision limit and it is estimated that by proper design the error could be reduced to 1:3000. **G. C. E.**

4224. Motion of an Electrified Corpuscle in Presence of a Magnetic Dipole. C. Agostinelli. *Accad. Sci. Torino, Atti*, 73. *Disp. 3a. pp.* 460-474, April-June, 1938.—The problem of the motion of an electrified corpuscle in presence of a magnetic dipole is considered, a problem closely connected with the theory of the aurora borealis. A new integral is developed first of all of the equations of motion and then the problem is reduced to that of the plane motion of a point acted on by a conservative force which is independent of the time. Finally a notable particular case is considered in which the problem is integrated by the method of the separation of the variables. J. J. S.

4225. Atomic Electron Velocities in Hydrogen. A. L. Hughes and M. A. Starr. *Phys. Rev.* 54. *pp.* 189-193, Aug. 1, 1938.—The distribution of energies among the electrons scattered inelastically by atomic electrons is determined by the distribution of energies among the latter in such a way that the curve representing the distribution of energies among the scattered electrons, above or below the most probable value, is identical in shape with the distribution of the component velocities among the atomic electrons. The latter distribution was found for energies between 1737 and 4040 eV in hydrogen for $\theta = 34.2$. The experimental curve is wider than the theoretical curve computed by Hicks by about 11% at the half-width and it is suggested that the theoretical assumptions may have to be modified. G. C. E.

4226. Neutron Scattering Cross-Sections. F. G. Brickwedde, J. R. Dunning, H. J. Hoge and J. H. Manley. *Phys. Rev.* 54. *pp.* 266-275, Aug. 15, 1938.—Measurements have been made of the transmission of liquid *p*- and *o*-H₂ for the slow neutrons obtained from a Rn-Be source by scattering in paraffin. As the neutrons captured by protons were less than 1% of the scattered neutrons, the scattering by the thin layers of liquid H₂ was determined from transmission measurements. The scattering cross-section of liquid H₂ for slow neutrons was found to depend on the velocity of the neutrons and on the ortho-para composition of the H₂. Two neutron energies were used—approximately 120° K. and 300° K. Values for the cross-sections at these velocities are given. It is shown that the interaction between neutrons and protons is dependent on the relative alignment of their spins, and that the singlet state of the deuteron is virtual. Values for the cross-section for capture and scattering together are given for N₂, O₂ and H₂O. G. O. B.

4227. Electron Diffraction by Split-Shutter and Back-Reflection Methods. R. Jackson and A. G. Quarrell. *Phys. Soc., Proc.* 50. *pp.* 776-782, Sept. 1, 1938.—The necessity for using the grazing-incidence method when electron-diffraction is applied to the study of surface structure is emphasised, and precautions to be taken in order to obtain the maximum information from the patterns are discussed. A satisfactory method for obtaining comparison reflection patterns by the split-shutter method is described, and details of a light-tight split-shutter plate-holder are given. In view of the limitations of the grazing-incidence method the possibility of the back-reflection of electrons is considered, and experiments are described in which high-speed electrons diffracted through angles approaching 180° are recorded photographically, the incident beam being normal to the surface of the specimen. The results obtained do not enable definite conclusions to be drawn concerning the two-dimensional or three-dimensional nature of the mechanism of diffraction involved, but development of the technique should result in a useful method applicable to those

specimens which cannot at present be directly examined by electron-diffraction.

AUTHORS.

***4228. Electron-Scan Microscope. Theoretical Fundamentals. M. v. Ardenne.** *Zeits. f. Physik*, 109, 9-10. pp. 553-572, 1938.—In a previous publication [see Abstract 2160 (1938)] it was pointed out that one of the main factors limiting the resolution of the electron microscope is the chromatic aberration arising from the variable velocity control of electrons in the object layer and object supporting foil. This form of chromatic aberration has been successfully eliminated in a new type of electron microscope devised by the author and termed the electron-scan microscope (*Elektronen-Rastermikroskop*). In this the object to be examined is explored by an electron-probe comprising an electron beam focused to an exceedingly fine point; the electron-probe is scanned over the object surface and by means of suitable electron detectors the scattering of electrons by each element of the object is determined and the fine structure of the object is pictorially reproduced. Suitable electron detectors are secondary emission multipliers, point-counter tubes, collector-electrodes coupled with valve amplifiers, and photographic layers. Besides the absence of chromatic error the electron-scan microscope has the advantage over the electron microscope that it can be applied to the examination of objects in free air; in this case the electron beam is scanned over the object through a Lenard window which serves as a support for the object. Practical details of construction of the microscope together with details of the practical results attained are reserved for a later communication.

J. E. K.

***4229. Short Magnetic Lens with Small Spherical Aberration. W. Glaser.** *Zeits. f. Physik*, 109, 11-12. pp. 700-721, 1938.—Simple expressions are derived for the spherical aberration of short electric and magnetic lenses and from these a short magnetic lens of minimum aberration is calculated. Numerical values of the radius of the diverging component are derived for a number of different fields.

H. J. H. S.

***4230. Simple Electron Microscopes. R. P. Johnson.** *J. of Applied Physics*, 9, pp. 508-516, Aug., 1938.—A brief description is given of a few of the simplest types of vacuum device which have been used by various investigators to produce images of metal surfaces by means of emitted electrons. These devices comprise essentially an electron emitting cathode and a fluorescent anode, the image on the anode is simply a projection of the cathode surface and the magnification depends on the geometrical disposition of cathode and anode. Examples are given of experimental results obtained with various geometrical arrangements, namely with cathode and anode as parallel planes, coaxial cylinders and concentric spheres. The devices described are not electron microscopes in the sense in which this term is normally applied inasmuch as they contain no electron-optical lenses for producing the image.

J. E. K.

***4231. Present Position of the Supermicroscope. B. v. Borries and E. Ruska.** *V.D.I.* 82, pp. 937-941, Aug. 6, 1938.—The development of the high power electron microscope since 1935 is briefly reviewed. The chief advances in its application have been made in the fields of bacteriology and colloid chemistry. L. Marton first entered the field of bacteriology and produced photographs of bacilli under magnifications of 750 diameters whilst later workers have increased this figure to some 20,000 diameters. Colloids of different types have also been examined under these high

magnifications. Applications have also been made in the fields of colour chemistry, medicine, biology, and soil physics. Illustrations are given of each of these applications. H. J. H. S.

***4232. Action of a Proton Tube.** T. Franzini. *Accad. Lincei, Atti*, 27. pp. 292–297, March 20, 1938. [See also Abstracts 3455 and 3908 (1934).]

See also Abstracts 3956, 4053, 4078, 4079, 4161, 4196, 4198, 4199, and 2911B. Apparatus for Measuring Scanning Speeds of Kathode-Ray Tubes. L. Blok.

ELECTROSTATICS.

See Abstracts 4203, 4266.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

4233. Conductivity of Lead Crystals at Low Temperatures in Strong Transverse Magnetic Fields. E. Justi and H. Scheffers. *Phys. Zeits.* 39. pp. 591–597, Aug. 15, 1938.—A method similar to that previously employed for Au, Al and W [see Abstracts 305 and 1732 (1938)] is now extended down to 1.8° K. to determine the effect of a transverse magnetic field, ranging up to 31 kGauss on the electrical resistances of two lead crystals. Whereas with W, application of the field had caused a considerable increase in resistance at 14° K., with Pb it is necessary to go to liquid He temperatures before this effect becomes very pronounced. The difference is attributed to the small characteristic temperature (88° K.) of Pb. The increase in resistance again depends on the angle the field makes with the crystallographic axis, whilst as for the other crystals studied the mean relative increase in resistance due to the field is a function of the ratio of the field strength to the resistance in the absence of the field. R. W. P.

4234. Thermomagnetic Anomaly at Ordinary Temperatures in Microcrystalline Ferromagnetic Substances. A. Michel and M. Gallissot. *Comptes Rendus*, 207. pp. 140–142, July 11, 1938.—To explain the anomaly in the magnetisation temperature curves of various ferromagnetic substances (Fe_2O_3 , various ferrites, etc.) according to the state of crystallisation, it is suggested that the Curie points of the minute crystallites in the microcrystalline varieties vary, being lower the smaller the crystallite, but always above 20° C., below which the normal law is followed. A hyperbolic form of curve may be due to physical as well as to chemical heterogeneity. [See Abstract 2818 (1937).] C. A. S.

See also Abstracts 4204, 4243.

MAGNETISM AND ELECTROMAGNETISM.

4235. Phase of Magnetic Field. K. F. Niessen. *Physica*, 5. pp. 769–774, Aug., 1938. *In German*.—A correction is made relating to the phase of a magnetic field in two important works on electric waves, viz., F. v. Mises' *Differentialgleichungen der Physik* and H. M. Macdonald's *Electric Waves*. H. J. H. S.

4236. Permanent-Magnet Alloys of Co, Cu and Ni. W. Dannöhl and H. Neumann. *Zeits. f. Metallkunde*, 30. pp. 217–231, July, 1938.—The phase diagram of the ternary system Co-Cu-Ni is determined by measurements of the thermal, microscopic, electrical and mechanical properties of a number of alloys of the system. The effect of different thermal treatments on the magnetic qualities is described and particular

emphasis is laid on the large effect of annealing time. Under optimum conditions, the alloys of this system have coercive forces of 100–1000 Oe and remanences of 7000–2000 G. The highest coercivity is observed in the alloy containing 20% Co, 60% Cu and 20% Ni but the alloy with the highest $BH_{\max}$ value has a smaller Cu content (41% Co, 35% Cu and 24% Ni). These alloys are relatively easy to work and in this respect are far superior to alloys of the Fe-Ni-Al and Fe-Co-Ni-Ti systems. The magnetic properties under optimum conditions of five alloys of the system are described in detail. H. J. H. S.

4237. Time Effects in Magnetisation. J. L. Snoek. *Physica*, 5. pp. 663–688, Aug., 1938. *In English*.—The influence of time in magnetisation manifests itself in three ways, *viz.*, magnetic viscosity, a reversible decrease of permeability and an irreversible decrease of permeability (magnetic ageing). A new theory is proposed to explain magnetic viscosity and the reversible time decrease of permeability. Experiments performed to test the theoretical deductions give good agreement, although the theoretical treatment does not cover the Jordan phenomena at higher frequencies. The basic assumption made is that the two time effects are related to a condition of strain existing in the barrier layer with respect to its immediate surroundings. H. J. H. S.

4238. Magnetic Properties of Thin Evaporated Iron Layers. K. R. Dixit. *Phys. Zeits.* 39. pp. 580–582, Aug. 1, 1938.—Experiments on films of Fe on mica show that the thickness of the film profoundly modifies the physical properties. A film of 1.1×10^{-5} cm. thickness oxidised in a few hours whilst one of 3×10^{-6} cm. thickness showed little change after 4 months. The electrical resistance of a film of 2×10^{-5} cm. thickness was approximately that calculated whilst for one of 10^{-6} cm. thickness the resistance was about 10^7 times greater than the calculated value. Films which are thicker than 200 atoms show magnetic isotropy whilst thinner ones exhibit anisotropy. H. J. H. S.

4239. Magnetic Anisotropy in Ferromagnetic Crystals in Weak Fields. Parts II and III. E. Kondorsky. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 5. pp. 397–404, 1938. *In English*.—In Part II the theory of the reversible susceptibility of ferromagnetic crystals first introduced by Gans is discussed for the case of weak fields. The processes which take place during magnetisation are described and from these the theory is built up. Formulæ are finally derived giving the reversible susceptibility. In Part III the reversible susceptibility of Fe crystals in various crystallographic directions is calculated from the formulæ already derived. The cases corresponding to a magnetic field parallel to (a) the direction [100], (b) the axis [110] and (c) the axis [111] are worked out. [For Part I see Abstract 3845 (1938).] H. J. H. S.

4240. Break in Magnetisation Curve of Iron Monocrystals in Weak Magnetic Fields. K. Honda and T. Nishina. *Zeits. f. Physik*, 109. 11–12. pp. 758–761, 1938.—The magnetisation curves of long monocrystal rods of iron, each grown in one of the main crystallographic directions, are measured with an astatic magnetometer of high sensitivity. It is found that the beginning of the magnetisation curve is a straight line through the origin, which is identical for all orientations. For each orientation there is a certain point at which the slope of the curve suddenly increases. The significance of this fact is discussed. R. P.

4241. Anomaly of Magnetite at Low Temperatures. R. Forrer. *Comptes Rendus*, 207. pp. 281–283, July 25, 1938.—The two existent

species of magnetite can be distinguished chemically by the action of chlorine and physically by their magnetic behaviour at low temperatures. The species which does not add chlorine, and natural magnetite, show an increase in magnetisation at about -138° , whilst the second species, which adds chlorine, does not show this anomaly. The anomaly appears to result from the rupture of a bond between two divalent Fe atoms situated at a distance of $3.64 \text{ \AA}$, each being attached to four O atoms. The anomaly has not been found with the ferrites in which the divalent Ni or Mg are already saturated by O_2 . W. R. A.

4242. Effect of Pressure on the Curie Temperature. H. Ebert and A. Kussmann. *Phys. Zeits.* 39. pp. 598-605, Aug. 15, 1938.—An investigation of the space-diagram magnetisation-pressure-temperature (I_s , p , T) as dependent on pressure up to 4000 kg./cm^2 , in the case of alloys of Ni-Al and Ni-Fe, with the object of connecting the Curie temperature with the atomic distance in the solution. At low temperatures, the effect of pressure on magnetisation diminishes. At high temperatures up to the Curie point, the effect of pressure on magnetisation increases, but with increased pressure diminishes, and the effect is the more marked the nearer the temperature to the Curie point. From the non-linear character of the I_s , p curves, it is concluded from extrapolation that the I_s , p , T surface approaches the p , T plane asymptotically, *i.e.*, that no finite pressure can reduce the ferromagnetism to zero. This is in line with the statement that the Curie temperature is unaltered by pressure. G. E. A.

4243. Magnetically Orientated Bismuth. A. Altma. *Ann. d. Physik*, 32. 6. pp. 489-506, July, 1938.—Particles of Bi powder were allowed to fall in a magnetic field. These orientated themselves with their chief crystallographic axis in the direction of the field, and a column of powder obtained in this way was compressed into a brick having the anisotropy of the Bi crystal and acting as an artificial single crystal. The anisotropy of the Bi powder was measured in terms of $\rho_{\max}$ and D , where $\rho_{\max}$ is the ratio of the maximum periodic change of resistance to the non-periodic change, and D is a measure of the moment of the directing couple on a 10 gm. mass of powder in a field of 10,000 gauss. These quantities are, for the single crystal, annealed powder and unannealed powder respectively: $\rho_{\max}$ 89, 42 and 19; D 7500, 4420 and 2640. A method is described by which the course of recrystallisation can be followed. Another method is given for making orientated single crystals in a vacuum without the aid of a starting crystal. G. E. A.

4244. Paramagnetic Dispersion in Chromium Alum and Its Interpretation. C. J. Gorter, P. Teunissen and F. Brons. *Physica*, 5. pp. 657-662, Aug., 1938. *In English*.—The decrease in the h.f. paramagnetic susceptibility of chrome alum in a strong parallel magnetic field is further studied [see Abstract 4208 (1937)], and the paramagnetic dispersion is shown in graphs of χ/χ_0 against the frequency of the alternating field, for temperatures 77.4°Abs. and 90.2°Abs. , and in fields of 800 to 3200 Oe. The results are compared with the theoretical considerations of Kronig and Casimir. G. E. A.

4245. Magnetic Studies on Rhodochrosite, MnCO_3 . K. S. Krishnan and S. Banerjee. *Zeits. f. Krist.* 99. 6. pp. 499-508, 1938. *In English*.—The paper gives a report of measurements on the magnetic anisotropy, and on the mean susceptibility at different temperatures, of rhodochrosite (MnCO_3). The mean susceptibility of the crystal is of the

order of $12,000 \times 10^{-6}$, per gm. mol. of MnCO_3 , at room-temperature, and its temperature variation conforms to the formula $\chi = 3.81/(T + 13)$, from which the magnetic moment of the Mn^{2+} ion comes out as 27.5 Weiss magnetons. The anisotropy of the crystal is very feeble, as should be expected, being about 7.2×10^{-6} per gm. mol. at room-temperature, which is only 0.06% of the mean susceptibility. This corresponds to a separation between adjacent levels in the Stark-pattern of Mn^{2+} , produced by the crystalline electric fields acting on it, of the order of 0.07 cm^{-1} .

AUTHORS.

4246. Magnetic Susceptibility of Au-Cu, Au-Ag, Ag-Cu and Cu-Ni Alloys. W. Broniewski, S. Franczak and R. Witkowski. *Ann. de Physique*, 10. pp. 5-19, July-Aug., 1938.—The magnetic susceptibility, χ , of Au-Cu (I), Au-Ag (II), Ag-Cu (III), and Cu-Ni (IV) alloys has been measured as a function of the composition by weight. The component metals were purified chemically or refined electrolytically and the preparation and subsequent treatment of the alloys were carried out *in vacuo* or in an atmosphere of H_2 . The diagram of (II), composed of continuous solid solutions, shows a curve slightly concave to the composition axis, whilst that of (III), formed of a mixture of weak solid solutions, approximates to a straight line. The diagram of (IV), composed of solid solutions, shows the continuous passage of paramagnetic to ferromagnetic alloys. The diagram of tempered (I), composed of continuous solid solutions, shows a curve similar to that of (II), but that of annealed (I) indicates the formation of the compounds Au-Cu and AuCu_3 . For certain alloys, e.g., (I), the χ curves enable the determination of structure which cannot be accomplished by other methods.

W. R. A.

4247. State of Ni in the α -Phase of Ni-Zn System. J. Dorfman and S. Sidorof. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 5. pp. 381-382, 1938. *In English*.—Using a modified Weiss balance the magnetic susceptibilities (χ) of five Ni-Zn alloys, containing from 16.1 to 20.25 atomic % of Bi, have been investigated at room-temperature. The samples represented almost pure γ -phases. For two samples χ is slightly diminished with increase of temperature but for the other three χ is temperature-independent. The γ -phase in Ni-Zn alloys possesses great diamagnetism and therefore the magnetic moment of the Ni atom is zero. The Ni is thus neutral and has its full complement of 28 electrons. This is in agreement with the Hume-Rothery rule relating to γ -phases.

W. R. A.

4248. Magnetic Susceptibility of Sm^{+++} Between 293 and 800°K . O. E. Frivold and L. Lunde. *Phys. Zeits.* 39. pp. 571-574, Aug. 1, 1938.—The mass susceptibility of Sm_2O_3 is given as a function of temperature as well as the ionic susceptibility of Sm^{+++} and the number of Bohr magnetons. The results for the relation between the number of Bohr magnetons and temperature agrees with that deduced theoretically on the assumption of a screening factor of 33.

H. J. H. S.

4249. Paramagnetic Relaxation. P. Debye. *Phys. Zeits.* 39. pp. 616-618, Aug. 15, 1938.—The relaxation time of an Fe ammonium alum was recently measured by de Haas and du Pré at the temperature of liquid He whilst Casimir and du Pré have derived a formula connecting susceptibility and frequency which is in agreement with experiment. The assumptions made by the latter are considered and a method is found for extending the argument to the more general case.

H. J. H. S.

See also Abstracts 3887, 3947.

MEDICAL RADIOLOGY AND ELECTROLOGY.

***4250. Electronic Cardi tachometer. J. W. Horton.** *Electronics*, 11. pp. 14-17 and 55, Aug., 1938.—Thermionic valves have been applied in the investigation of the electrical currents related to the action of the normal and pathological heart, since the early work of P. Boaz and B. Liebowitz in 1928. The wave-form of the electrocardiograph, on analysis, gives information in respect to the energy distribution of the components, the fundamental component being determined by the heart rate and having a much greater fundamental frequency in mice than in the human subject. An 8-valve apparatus for such investigation is illustrated and described.

B. J. L.

***4251. Nomogram for Radiographic Mensuration. H. J. Holmquest.** *Radiology*, 31. pp. 198-205, Aug., 1938.—A nomographic chart has been constructed to facilitate the radiographic determination of linear dimensions, such as diameters, chords, or perimeters which lie in planes parallel to the film. From known and readily measured parameters, the diameter or perimeter of a radiographic image can be determined by means of the chart, without any calculations. The dimension obtained from the chart is the dimension of the projection from the focal spot of the object radiographed, on a plane passing through the centre of the object and parallel to the film. This dimension is somewhat greater than the corresponding dimension of the section of the body determined by the intersecting plane through the centre of the body and parallel to the film. However, for the anode film distances employed in radiography, it is shown by mathematical analysis that the error in dimension is negligible. The nomogram is constructed for anode-film distances of 10-84 in. and object-film distances of 0-30 cm. and it is effective for measured dimensions up to 75 cm.

T. A. C.

***4252. Kineradiography by the Indirect Method. R. Reynolds.** *Radiology*, 31. pp. 177-182, Aug., 1938.—A historical survey is made of attempts to produce kinematographic records by means of X-rays, by the two possible methods. The direct method consists of exposing serially comparatively large films, the pictures being then reduced to normal size for projection purposes. In the indirect method an ordinary kinematographic apparatus with a wide-angle lens is used to photograph the X-ray shadow on a fluorescent screen. The author contends that as a result of improvements in recent years in tube and screen construction, and in photographic technique, the indirect method is now sufficiently practicable for ordinary hospital use. A short account of the method is given, together with examples of its use in the examination of moving joints, heart and gastro-intestinal tract.

J. E. R.

4253. Stray-Radiation Survey of X-Ray Installations. C. B. Braestrup. *Radiology*, 31. pp. 206-213, Aug., 1938.—The first part of the survey deals with the stray radiation intensity in the immediate neighbourhood of a number of enclosed tube holders. It is shown that these normally provide sufficient protection for the patient; on the other hand, even when the shutters are closed the protection for operators during routine manipulations in the X-ray cubicle is usually inadequate. It is suggested that the term "ray-proof" for such tubes is ambiguous and should only be used for apparatus where the stray radiation is less than 0.036 r.hour at 1 m. focal distance. Details of more comprehensive stray radiation measurements on some 20 installations are given side by side with the protective arrangements in each case. It is shown that by

careful arrangement of protective materials, a high factor of safety can be obtained at a considerably reduced cost. Several cases of insufficient protection were corrected as a result of this survey. J. E. R.

***4254. Concrete Protection against Hard X-Rays.** F. Heidenreich and R. Jaeger. *Phys. Zeits.* 39. pp. 541-546, July 15, 1938. *From the Reichsanstalt.*—A short description is given of the 800 kV generator and the 500 kV X-ray tube in use at the Reichsanstalt. Curves are given showing the relative protective powers of lead and concrete in the voltage range 150 to 500 kV for various filtrations. The ratio of thicknesses necessary to reduce the radiation to the tolerance dosage rate decreases from 80 to 15 in this voltage range. In view of this decrease, concrete is recommended as a protective material for hard radiations. The results are compared with a curve calculated by Rump for monochromatic radiations. J. E. R.

***4255. γ -Ray Measurement.** W. Friedrich. *Am. J. of Roentgenology and Radium Therapy*, 40. pp. 69-79, July, 1938.—The difficulties of intensity measurement of γ -rays, are discussed in respect to the effects of the ionisation chamber wall material and thickness and scattered radiation. Large dimensions in barrel chambers have not led to consistent evaluations and, with small chambers, the wall thickness causes great variations. Measurements in this respect, with an apparatus illustrated, are given in large detail and show that measurements for isodosis curves for γ -rays in terms of röntgens, are only possible by use of an ionisation chamber of air equivalent material and sufficient wall thickness, after removal of the scattered γ -radiation. Under these specified conditions a value in "r" units is found of 7.8 r. per mg.-hr. B. J. L.

***4256. γ -Ray Measurement.** G. W. C. Kaye and W. Binks. *Am. J. of Roentgenology and Radium Therapy*, 40. pp. 80-91, July, 1938.—The "r" unit of X-ray dosage is defined, for the measurement of which "free-air" and "air-wall" ionisation chambers are utilised. The use of this unit for the measurement of γ -rays is discussed and experience shows differences in measurements with free-air and air-wall chambers. A large free-air parallel-plate ionisation chamber is described and illustrated and measurements considered in respect to "natural" ionisation in such chambers, which show the measured ionisation of a γ -ray beam from a point source of 1 mg. of Ra filtered by 0.5 mm. of Pt over 1 hr. at 1 cm. distance equals 7.9 r. Results with air-wall chambers are then discussed, and with these, a value of 8.0 r. is obtained. The results are compared with the findings of other investigators, possible sources of error being discussed. The air-wall chamber in respect to clinical use has definite limitations when the chamber wall is thick but, in view of the fragility of thin wall chambers, they have definite practical application. A modification is suggested in respect to the present definition of the "r" unit. B. J. L.

See also Abstract

2947B. Life, Death and Short-Wave Radiation. S. G. Hibben.

OSCILLATIONS AND WAVES.

4257. Triode Hysteresis. A. Iskander. *Gerlands Beitr. z. Geophys.* 53. 4. pp. 277-284, 1938. *In English.*—With a view to geophysical applications the influence of periodic capacity variations on triode hysteresis is studied. AUTHOR.

***4258. Stable-Frequency Valve Oscillators.** Y. Rocard. *J. de Physique et le Radium*, 9. pp. 237-240, June, 1938.—It is possible so to design a valve oscillator that the frequency is determined solely by the constants of the oscillating circuit and does not vary with the internal resistance of the valve. The method described by the author consists in putting the tuned circuit in the anode connection but putting in series in the grid and anode circuits impedances of suitable value. F. S. B.

***4259. Short-Wave Oscillator.** T. V. Ionescu. *Comptes Rendus*, 207. pp. 54-57, July 4, 1938.—This paper describes arrangements which have been used for the production of oscillations and gives a description of the appearance of the discharge in the tube under various conditions. A formula is given for the wave-length with some experimental results in verification. Depending on the size of tube, distance apart of plates, applied potentials, gas pressure and strength of field, waves between 12 cm. and 144 cm. have been generated. [See Abstract 3281 (1937).] F. S. B.

4260. Critical Frequency of Radio Waves Reflected Obliquely from the Ionosphere. F. T. Farmer, C. B. Childs and A. Cowie. *Phys. Soc., Proc.* 50. pp. 767-775, Sept. 1, 1938.—Experiments are described which compare the *F*-region skip frequency, for transmission between two distant stations, with that calculated from the normal-incidence characteristics on a simple ray theory. The greatest possible accuracy was aimed at so that the results might resolve an uncertainty left in previous measurements, in which the forms of the oblique and normal incidence *Pf* curves were compared. This involved using a pulse-transmitter at each end of the oblique trajectory to correct for horizontal variations of ionisation, and developing a special rapid technique. Measurements were confined to days when the ionosphere was in a completely undisturbed state, as shown by the clean splitting of echoes at normal incidence. The results showed that the theory, which neglects the earth's magnetic field, is very nearly correct for the ordinary wave over a transmission distance of about 500 km. The precise disagreement is determined, and it is believed that if an accurate theory be developed the results will indicate whether or not the Lorentz term should be included in the analysis.

AUTHORS.

4261. Ionospheric Transmission at Oblique and Vertical Incidence. G. Millington. *Phys. Soc., Proc.* 50. pp. 801-825, Sept. 1, 1938.—This paper gives a modification for a curved earth of Martyn's theorems, relating oblique-incidence ionospheric phenomena with observed conditions at vertical incidence. The theorems in their modified form are shown to hold, as regards both equivalent frequency and absorption, for a relatively thin layer above the earth's surface. It is assumed that the ionic density has the same vertical gradient everywhere between the transmitter and receiver, and the effect of the earth's magnetic field can be neglected. Methods of allowing approximately for these two factors are discussed. A set of transmission curves is derived, with which the skip frequency at any given distance from the transmitter can be obtained graphically from an observed *Pf* curve at vertical incidence. Similar curves are given for deducing equivalent heights and angles of elevation at oblique incidence, together with graphs of the maximum receivable frequency at extreme distances and the maximum distance of single-hop transmission, as functions of the height of the layer. The application of

the theorem is thus reduced, for the benefit of engineers, to a simple technique of using a number of standard curves in conjunction with a given $P'f$ curve. AUTHOR.

See also Abstracts 3944, 4011 and

- 3054B. Study of Ionosphere at Torrechiarruccia. A. Bottini.
 3055B. Changes in Ionosphere during Aurora. B. Beckmann, W. Menzel and F. Vilbig.
 3056B. Changes in Transmission Conditions for 10m. Waves, 1935-7. E. Fendler.
 3058B. Experimental Research on Propagation of Ultra-Short Waves. W. Ochmann and H. Plendl.
 3059B. Surmounting the Earth's Curvature by Ultra-Short Waves. G. Eckart and H. Plendl.
 3060B. Diffraction Theory of Propagation of Ultra-Short Waves. G. Eckart.
 3061B. Diffraction and Refraction of Radio Waves round Earth. T. L. Eckersley and G. Millington.
 3062B. Electromagnetic Waves in Elliptic Hollow Metal Pipes. Lan Jen Chu.

PHOTOELECTRICITY.

***4262. New "Positive" Barrier Plane Photoelectric Effect and the New Barrier Plane Photo-Cell.** B. Kolomiez. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 5. pp. 383-384, 1938. *In English.*—The action of barrier plane photo-cells is described. It has been found that thallium sulphide cells in which the ThS is in the state of electron conductivity exhibit a barrier plane photo-effect but with the inverse sign. Electrons thus pass from the metal into the semiconductor, charging it negatively. Such cells have a sensitivity which is 10 times as great as Se cells under the same conditions of illumination; the e.m.f. reaches 0.3 V; the dependence of the short circuit current and of the e.m.f. on the illumination do not differ from those of Se or Cu_2O cells whilst the spectral sensitivity is the same as that of the thalofides.

H. J. H. S.

See also Abstract 4264.

PIEZOELECTRICITY.

4263. Diffuse Scattering of X-Rays from Piezoelectrically Oscillating Quartz. G. E. M. Jauncey and W. A. Bruce. *Phys. Rev.* 54 pp. 163-165, Aug. 1, 1938.—Bertsch's investigation [see Abstract 1381 (1936)] of the effect of the different modes and types of piezoelectric oscillations of quartz on the intensity of Laue spots and Bragg reflections necessitates a similar investigation of the effect of the different modes and types of vibration on diffuse scattering. Extending the result found by Jauncey and Deming the authors find that in all cases the piezoelectric oscillations have no effect on the intensity of the diffuse scattering. Since the diffuse scattering cannot be affected by secondary extinction, it is concluded that the change of intensity of the Laue spots is due to a decrease of secondary extinction in the body of the crystal. AUTHORS.

See also Abstract

- 2900B. Piezoelectric Measuring Apparatus. R. K. Hellmann.

THERMIONICS.

4264. Electron Movements at Exterior Boundary Surfaces. R. Suhrmann. *Zeits. f. Elektrochem.* 44. pp. 478-488, Aug., 1938.—This paper is limited to a brief review of the most important regularities of electronic emission at external boundary surfaces, after which the author considers some important problems of particular theoretical interest. The emissions first discussed are those from metals when heated

to high temperatures *in vacuo*, and when submitted to light irradiation, to electronic bombardment and to the influence of strong electric fields. Then follows a discussion of the electronic properties of pure metallic surfaces, the dependence of the thermionic work function on the position of the element in the periodic system and on the orientation of the crystal faces, and the relationship to the electrochemical behaviour. Next the electronic properties of metallic surfaces which contain foreign atoms are treated, and the electrical state of the adsorbed atoms ascertained, this being important for the catalytic behaviour of metallic surfaces. By increasing the number of alkali metallic atoms on a metal surface, the thermionic work function is reduced until a value is attained somewhat below that for a monatomic coating but rises again to the value for a compact alkali metal. The mechanism of the electronic solution below and above the critical value is throughout different. Finally those emission properties which are important for technical purposes are described, *e.g.* photo-cells. Several analogies are pointed out between electric and photographic processes, and 15 diagrams with a Bibliography of 57 references completes a valuable paper.

H. H. Ho.

4265. Work of Removal of Electrons from Metals. O. Klein and E. Lange. *Zeits. f. Elektrochem.* 44. pp. 542-562, Aug., 1938.—This very comprehensive paper deals with the thermionic work function ($-a_0$) of metals under the following headings: (a) The present position of knowledge with respect to the $-a_0$ values of pure metallic surfaces. This section includes processes for the preparation of pure metallic surfaces; the $-a_0$ values of differently orientated single crystal surfaces; the influence of changes of modification of the whole phase on $-a_0$; temperature dependence of $-a_0$ at pure polycrystalline metallic surfaces; surface influences of vacuum distilled metals on $-a_0$; influence of mechanical treatment upon the structure of surface and thereby upon $-a_0$. (b) The influence of adsorption by impurities such as gases and vapours upon $-a_0$ values of metals. The gases and vapours studied were A, He, N₂, H₂, atomic H and H⁺ ions, O₂, CO, CO₂, H₂O, NH₃; the effect of a glow heat on the metal was investigated. (c) Methods for the measurement of Volta potential $\Delta\psi$ Hg/Me, with full experimental details. (d) The evaluation of the data, wherein 12 sets of curves and a table of results for 45 elements are included. In (e) the final data are assembled and a periodic chart constructed for the $-a_0$ values of the elements. The latter periodicity is then discussed.

H. H. Ho.

4266. Contact Potential and Exit-Work. W. Heinze. *Zeits. f. Physik*, 109. 7-8. pp. 459-471, 1938.—The exit-work for the thermionic emission of electrons from W and Ta was determined from the slope of the Richardson line. The contact potentials of the same two metals with respect to W were measured by the thermionic-valve method. It was established that the difference in the exit-works equalled the difference in the contact potentials.

W. S. S.

4267. Influence of Adsorption Layers upon the Impact of Positive Cæsium Ions in Tungsten. H. Paetow and W. Walcher. *Zeits. f. Physik*, 110. 1-2. pp. 69-83, 1938.—Previous investigators have noticed that electron liberation and ion reflection are greatly dependent on the condition of the surfaces, but Koch was the first to prove the alteration of the electron liberation and ionic reflection on the production of an alkaline layer [see Abstract 4424 (1936).] The author systematically investigates the influence of ad-atoms and surface compounds on the

phenomena mentioned. The number of the electrons set free on the bombardment of W with positive Cs ions is strongly increased by adsorbed layers. It is shown that additional electrons are set free from the ad-atoms. The number of the reflected electrons is likewise very much dependent on the existence of adsorption layers. For this the exit-work of the surface is decisive. J. J. S.

***4268. Engine for Smoothing Small Tungsten Wires.** R. P. Johnson, A. B. White and R. B. Nelson. *Rev. Sci. Instruments*, 9. pp. 253-255, Aug., 1938.—The grooves left on drawn W wire by the diamond die cause difficulty in the interpretation of thermionic emission, adsorption and related phenomena. A machine is described whereby such grooves can be removed from wire 2-10 mils in dia. by mechanical abrasion. Automatic control is incorporated so that the machine runs continuously without attention except for changing the abrasive. The wire is stretched taut between two chucks geared together and the abrasive is pushed by a lead screw along the rotating wire. The marks left by one passage of the abrasive are crossed approximately at right angles on the return trip. The standard grinding schedule, occupying some 90 hr. in all, is described. A reduction of some 15% occurs in the dia. of the wire and whilst the finished wire tapers slightly from the centre towards the ends, it is claimed that a 25 cm. length cut from the middle of a 40 cm. ground piece shows a variation in mean dia. of less than 1%. A. G. Q.

THERMOELECTRICITY.

4269. Theory of the Thermoelectric Properties of Alloys. T. Muto. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers*, No. 798. pp. 741-750, July, 1938. *In English*.—It is shown quantum-mechanically that for the electrical resistance of a metal or alloy the following classical expression is still valid at temperatures above Θ ; viz., $\rho = (m/Ne^2)(1/\tau)$, where N is the effective number of the electrons per unit volume (defined in accordance with the quantum theory of metals) and τ is the time of relaxation, which latter quantity is shown to be inversely proportional to the electron scattering probability due to the thermal motion of the crystal lattice, alloy formation, etc. Now Nordheim has shown quantum-mechanically that the expression for τ for an alloy has the form $1/\tau = 1/\tau_0 + 1/\tau_p$, provided the alloy consists of a single phase. τ_p is due to the thermal vibration of the atoms situated at lattice points, as for a pure metal, while τ_0 is due to the alloy formation from different kinds of atoms, the residual resistance being inversely proportional to τ_0 . It is shown that the thermoelectric power depends on the atomic concentration of the component metals of an alloy through the quantities τ_0 and τ_p . This is discussed in detail and comparison is made with experimental results. In particular the thermoelectric power of dilute solid solutions of the noble metals is dealt with, and also the reasons for the fact that the thermoelectric power of the noble metals is positive in sign, whereas the sign of the alkali metals is negative. J. J. S.

See also Abstract 4206.